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GEOLOGICAL SURVEY OF ALABAMA

EUGENE ALLEN SMITH, *State Geologist*

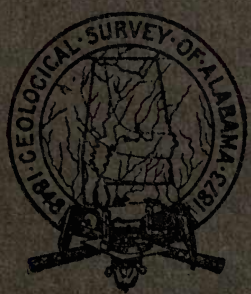
BULLETIN NO. 24

MICA DEPOSITS OF ALABAMA

BY

GEORGE HUNTINGTON CLARK

ASSISTANT GEOLOGIST



UNIVERSITY, ALABAMA

1921

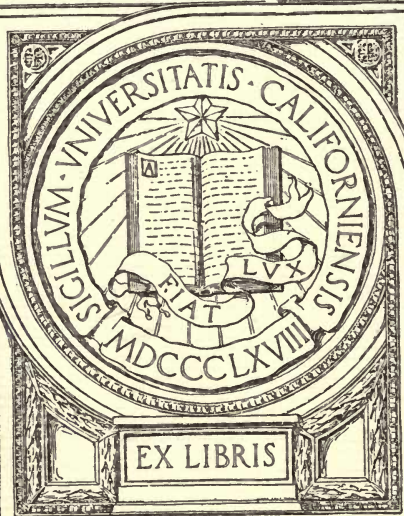
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GEOLOGICAL SURVEY OF ALABAMA

EUGENE ALLEN SMITH, *State Geologist*

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MICA DEPOSITS OF ALABAMA

UNIVERSITY, ALA. SEPTEMBER, 1921.
BY
GEORGE HUNTINGTON CLARK
ASSISTANT GEOLOGIST



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Geological Survey of Alabama

Geological Survey of Alabama

REGINE ALLEN SMITH, M.D., GEOL.

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UNIVERSITY OF ALABAMA

1921

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PART I

GEOLOGICAL SURVEY

LETTER OF TRANSMITTAL

UNIVERSITY, ALA., SEPTEMBER, 1921.

HON. THOMAS E. KILBY,
Governor of Alabama,
Montgomery, Alabama.

Sir: I have the honor to transmit herewith the manuscript of a Report on the Mica Deposits of Alabama by George Huntington Clark, with the request that it be printed as Bulletin No. 24, of the Geological Survey of Alabama.

Very respectfully,

EUGENE A. SMITH,
State Geologist.

A

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GEOLOGICAL CORPS.

Eugene Allen Smith, Ph.D.	State Geologist
William F. Prouty, Ph.D.	} Assistant Geologists on Special Work.
George I. Adams, D.Sc.	
George H. Clark, C. E.	
Robert S. Hodges	Chemist
Roland M. Harper, Ph.D.	Geographer and Botanist
Mrs. Herbert H. Smith	Acting Curator of Museum
Truman H. Aldrich	Honorary Curator of Mollusca
Rev. H. E. Wheeler	Assistant in Paleontological Work
George N. Brewer	Field Assistant
A. T. Donoho	Secretary

RIVER GAGE HEIGHT OBSERVERS.

Tallapoosa River at Sturdevant, Ala.

A. L. Stow.....Alexander City, Ala.

Elk River at Elkmont, Ala.

Dr. William E. Maples.....Elkmont, Ala.

Observations are made every day by these observers of the gage readings at the several stations. From these records when extended through sufficient time, the calculation of available horse power to be obtained from the different streams is made.

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THE MICA DEPOSITS OF ALABAMA

PART I.

GENERAL DISCUSSION.

INTRODUCTION.

FROM its indispensable character in many vitally important industries, and by reason of the failure as yet to find or provide a satisfactory substitute for it in certain of its most important and rapidly increasing uses, mica has become one of the most essential and therefore valuable of all the mineral products.

Although one of the most widely distributed of all minerals as a component part of the various rocks, workable deposits of mica, from which may be recovered the grades and the quality chiefly in demand, are not only limited in number, but are also at very many points of origin, inaccessibly located with respect to transportation, and largely handicapped as to economic recovery by the irregularities and uncertainties always incident to its mode of occurrence.

Of the distinct varieties of mica occurring in the United States, six have been to greater or less extent mined, viz: muscovite, phlogopite, roscoelite, lepidolite, biotite, and mariposite. Only two of these varieties, muscovite, and phlogopite, have received any general application in the industries, and have constituted therefore the major part of present mine recoveries.

As regards extent and availability, and their more comprehensive uses, indispensable to the electrical industry as a vital factor in its enormous expansion, the varieties of muscovite, having the same chemical composition and varying only in physical characteristics, are the basic factors at the present time in domestic mica mining and manufacturing.

Phlogopite, next in order of commercial importance, is of small and infrequent domestic occurrence, the sup-

ply being largely imported and mainly drawn from Canada.

Biotite, occurs to some extent in Alabama mica mines, but not in recoverable amounts.

Roscoelite has value only as a source of vanadium, and lepidolite mainly as containing a small percentage of lithium. Mariposite finds limited uses in the arts by reason of its color. None of the last named varieties have been as yet identified or have received any attention in this State.

PRODUCTION.

Prior to the Great War, the world's supply of mica had been largely drawn from India, Canada, and the United States, with lesser but considerable amounts supplied mainly from Brazil, Southwest Africa and Ceylon.

The United States during the pre-war period, was never able to produce more than forty per cent. of its consumption of sheet mica, and in the higher grades, meeting the requirements for high-potential electrical uses, its maximum production fell far short of that percentage of its requirements.

As the estimated total annual consumption and production of sheet mica approximately balance, practically all the sheet mica annually mined, being consumed; the necessities for the carrying out of Government orders alone, wholly irrespective of other requirements, for the year 1919, called for at least 1,000,000 pounds, or 500 short tons, of which amount three-fourths necessarily therefore, required to be imported muscovite. Average annual domestic requirements under normal conditions prior to the war, having approximated 1700 tons of sheet mica, substantial increases in production under the stimulus of the relatively higher level of war prices were imperatively demanded and confidently looked for but were only partially realized.

Similar shortages, and the necessity for speeding up production under the war regime but under more difficult conditions of realization, existed also coincidentally abroad, and were necessarily of world-wide extent.

The comparatively small increment realized in world production of sheet mica, however, under the heavy pressure brought to bear on this industry by reason of existing war necessities and conditions, may in some measure indicate, with due and proper consideration of the difficulties and obstacles incident to such a sudden and wholly unexpected demand for heavily augmented output of existing mines, possible definite limitations in the sum total of mica reserves as at present known.

World production of sheet mica, averaging at the present time about 3,000 short tons annually, is derived from the following definite sources as to its distribution nationally.

North America: United States, Canada, Guatemala, and Mexico. *South and Central America:* Brazil, Argentina, Chile, Costa Rica, and Peru. *Europe:* one source only, Norway. *Africa:* German East Africa, Union of South Africa, Madagascar, Nyassaland Protectorate, Rhodesia, Protectorate of Southwest Africa, and Kamerun. *Asia:* India, Ceylon, Chosen, China, Japan and Siberia. *Australasia:* Australia and New Zealand.

The chief source of the world's supply of sheet mica is now and always has been India, where the industry originated several centuries ago, and where there are at the present time over 15,000 men, women and children employed in mica mining and handling.

The continuous and steady growth of the industry in India has been due to the outstanding facts, that from its long and regular period of operation, the difficulties and obstacles in the way of successful mica mining are there better understood and more competently dealt with, low cost labor is abundant, satisfactory, and sufficiently skilled, and the necessary processes of preparing and of grading mica stocks prior to shipment, are properly made use of; a vital condition for successful operation, singularly lacking in very many attempted mica recoveries elsewhere. Beginning with the first reliably recorded output in 1890, of 346 short tons, the average annual production from 1901 to 1917 was 1823 short tons, reaching a maximum of 2579 short tons in 1918, confined largely to the Bihar and Orissa Fields, which in final analysis

means; that during the above defined period, India furnished over 60 per cent. of the world's sheet mica, amounting to practically three-fourths of the world's sheet muscovite, as against a coincident and relative production in the United States of less than 20 per cent. When it is remembered, however, that the average labor cost for men, women and children in the East Indian mica district averages less than 30 cents per diem, and that the product of this field, re-shipped from England, has benefited by the further advantage of ruling and favorable exchange rates, the above stated relative percentages become more understandable. Of the total sheet mica output, Bengal has supplied about three-fourths, the remainder being drawn from Madras, with the exception of very small amounts from Rajputana.

Prior to the war, although considerably over half of the sheet mica exported from India went uniformly to the United Kingdom, its ultimate consumption after re-shipment, is difficult to trace. It is stated, and seems probable, that Germany at that time absorbed the larger part of it, the United States, by direct and indirect shipments, receiving not much more than one-fourth of such exports.

Systematic study, given to the mica industry by the India Geological Survey during the war, with a view to pointing out and opening up new occurrences, and to the re-working of the old mines by new and more efficient methods, tends to show that the future of mica mining in India is very promising, and would seem to indicate that if the present preferential conditions as to mine cost and available markets continues, that country may easily sustain its present lead in production.

As regards American consumption, Canada is practically the only commercial source of phlogopite, although small amounts have at various times been recovered from Ceylon, Madagascar and South Africa.

Expressed in terms of sheet mica, inclusive of splittings, its precise quota of world's production is difficult to estimate, owing to the form of the statistical information available as published by the Canadian government. Assuming however, one-half of the total production re-

ported to be sheet mica; that is cut, uncut, and splittings, the output of the Canadian mines for the period 1906 to 1917, is approximately stated at 11 per cent. of the world's production, averaging annually for that period about 357 short tons, with but small fluctuations. Very little of the India mica mined is consumed locally. For the period 1912 to 1916, 81 per cent. of its output exported, went to the United States, and 17 per cent. to Great Britain.

South American exports, negligible before the war, have recently made notable advances chiefly in Brazil and in Argentina. In Brazil, the mica deposits, located fairly accessibly to railroads for transportation to port, mainly in the adjacent and contiguous states of Bahia, Goyaz, Minas Garaes, and Sao Paulo, have received recent increased development, considerable amounts of mica being recovered from them during the war period, comparing favorably as to grade with India mica, and running in size up to large plates 20 by 10 inches, with supplies indicated as obtainable, 6 by 6 inches in size. The interior Province of Goyaz, while much less accessible, has been recently reported to contain very large deposits, the natives having long used it for window panes. The output of the Brazilian mines prior to 1913 was negligible, amounting to less than 10 tons per year. Under war stimulus however, and because of the excellent quality of the mica produced, its output has heavily increased, amounting in 1917 to 106 tons, or nearly 3 per cent. of the world's production, and 10 times its pre-war recovery.

The proportion of Brazilian mica coming to the United States has always been large and is increasing, considerable capital has been invested, and present production may be maintained in spite of existing difficulties due to serious lack of transportation facilities and of efficient labor, and to unfavorable climatic conditions.

The mica deposits in Argentina lie mainly in the remote and difficultly accessible mountain provinces of Cordoba and San Luis, and not having been competently developed, shipments made have generally been of inferior grade, known and classified as stained or spotted mica. Recent shipments of muscovite have, however, included some good clear sheet mica, the available percentage of

which may be subject to material increase although still inferior to similar Brazilian grades. The average annual production for the period 1908 to 1913, was approximately 10 short tons, amounting in 1917 and 1918, to about 2 per cent. of the world's production. Of this production the United States received less than half, most of the residue going to England.

Peruvian production and exports have been thus far so small as to be negligible. Shipments made mainly in an experimental way from Guatemala, have not proven generally satisfactory, the mica recovered being of greenish color, splitting badly, and proving after test unsuitable for electrical purposes. As the cost of production is exceptionally high, owing to unfavorable mining conditions in respect to occurrence, insufficient labor, and defective transportation, no material increase in the recovery of mica of acceptable grade is at present probable from the Guatemalan District, although recent exploitation by surface workings only of new deposits in the Department of Quiche, developed some mica of better grade running to larger sizes.

Production in Norway, confined to one locality near Skutterud, on the southwestern coast, has been justified during war conditions only, and is not likely to be continued, as the mica recovered has been mostly small and of inferior quality.

African production of sheet mica, although distributed over an extremely wide area, is mainly confined as to probable permanence and present importance, to former German East Africa, where mica occurs in ten different localities, the most valuable deposits being found in the Uluguru mountains. The sheet mica recovered has been of high grade, dark green or brown muscovite, unusually clear and transparent, largely free from imperfections, and occurring very frequently in large crystals. Limited amounts of phlogopite have also been recovered, but of generally inferior quality and of small commercial value.

The output of German East Africa, from 1908 to 1913, averaged 127 short tons, constituting in 1913, 4.3 per cent. of the world's production. During the war, this production was materially increased advancing this Dis-

trict to fourth place, (after India, the United States, and Canada), in production of sheet mica, and making it third in importance, on the basis of the actual value of world output of sheet muscovite.

In the Union of South Africa, practically all the known deposits of value are in the Transvaal, existing operations having been confined to three localities. The mica recovered has been commonly of large size but of somewhat defective structure in the crystals, limiting the amounts of recoverable sheet in these larger books. The brownish muscovite of the Leydsdorp field, however has proved to be equal to the best grades of Indian and Canadian mica for electrical purposes. In recent Memoir No. 13 of the Geological Survey, Department of Mines and Industries, Union of South Africa, a mica belt is reported of some 300 square miles in area, which has been worked to a considerable extent since 1909, but until the opening of the Selati Railway in 1912, which now crosses the mica field, the nearest railway shipping point has been 120 miles distant. In reviewing the operations of six operating companies, the finding of some exceptionally large blocks is noted, but as a whole the merchantable mica recovered, although of favorable grade, is stated to have been mainly in comparatively small sizes. Some idea of mining conditions and cost of recovery may be gained from the stated fact in Memoir No. 13, that to procure one ton of mica, trimmed and in marketable condition, it has here been found necessary to mine from 850 to 1700 tons of rock. Also the great waste in this field, suitable for grinding purposes, has been practically unused. During the period 1909 to 1917, the Transvaal output, averaged annually only about four tons. Recent export figures, although not as yet available, would probably not show this field of much relative importance.

Only small production is noted from the Island of Madagascar, the last annual output reported in 1913 being 6 tons, although something like 125 tons per year is stated to be a possible expectancy. The mica mined consists of both muscovite and phlogopite. Only a small proportion of the muscovite is clear sheet, the greater part of it being discolored or spotted. With the excep-

tion of the Nyassaland Protectorate, which has produced some little clear sheet; the remaining Africa mica fields in Rhodesia, Kamerun, and the Protectorate of Southwest Africa, are of no commercial importance.

Of the Asiatic deposits, the known occurrences outside of India have practically as yet no tangible commercial value. Ceylon, as far as known has an annual output averaging only about 5 short tons, with a reported maximum in 1907 of 23 tons made up altogether of phlogopite, the grade of which has not as yet been demonstrated. Chosen, (Korea) has long produced small amounts of both muscovite and phlogopite, which have been altogether made use of locally. China contains some large deposits, mainly remote from transportation, but the grade of mica recovered from such deposits as have received exploitation has been inferior, and the extent and value of existing mica reserves has yet to be altogether proven.

Japan has as yet no developed mica resources of which any definite knowledge has been obtained, and it is questionable whether such resources exist although reported to be present, in as much as the rapid growth of the electrical industry in Japan, which has in recent years changed it as a nation from an exclusive importer to an exporter of electrical goods, would have probably brought about the development of such mica resources if in existence.

Siberian deposits have recently received some attention, muscovite in the clear sheet, mainly small, but of occasional very large sizes, having been mined, but by reason of climatic drawbacks and remoteness from transportation, are hardly to be considered as present sources of supply.

Australia carries very extensive and workable deposits of sheet mica mainly in the central part of the island, the muscovite recovered being in large, clear sheets of light color, unusually free from flaws or imperfections, sheets running from twelve inches to several feet in width having been mined. It has been stated that the Harts Range deposit is one of the largest and most important mica deposits known to exist, although the com-

paratively small known present production indicates as yet a limited development.

Western Australia, in addition to valuable deposits of muscovite sheet mica, carries also notable deposits of lepidolite in the clear sheet, running to large sizes. South Australia realized a production in 1917 of 38 tons, which was however of indifferent grade, and of low value. Queensland has had no stated figure of production, the deposits opened up and which carried good muscovite, lying too remote from transportation to justify present development.

The mica produced and sold in the United States,* as reported to the United States Geological Survey, amounted in 1918 to 3114 short tons, and the sheet mica marketed, to 1,644,200 pounds, an increase in quantity of 29 per cent. over 1917, but a decrease of nearly 3 per cent. in estimated value. The quantity and value of scrap mica produced—2,292 short tons—were the smallest reported since 1906. During the first nine months of 1920, the industry was prosperous, with corresponding resultant production, but with the general industrial decline during the last quarter, market demands rapidly declined, and prices dropped from 10 to 20 per cent. Importations for the first 10 months of 1920 were nearly double those of the preceding year, amounting to 1,375,927 pounds of uncut mica valued at \$1,206,443, and of cut mica to the estimated value of \$1,656,182. Exports of mica for the same period mainly in the form of manufactured products, were valued at \$242,381, or about 10 per cent. of the value of imports. As a result of these heavy importations, at prices largely eliminating domestic competition, production during the closing months of 1920 declined heavily, North Carolina mines furnishing the bulk of the American output, being at present largely idle, and hundreds of men and women dependent altogether on the mica industry for the means of subsistence have been thrown out of employment. It has been estimated from reliable sources that the South alone, possessing mica resources largely undeveloped and favorably

*U. S. Geological Survey Mica in 1918.

conditioned, is capable, under merely a reasonable and fair temporary measure of tariff protection, of mining and of shipping mica to the value of five million dollars annually.

Ten states furnished the production reported for 1918, being in the relative order of the sheet mica recovered, North Carolina, New Hampshire, Georgia, Virginia, South Dakota, Alabama, Colorado, South Carolina, New Mexico and Wyoming. North Carolina, as always heretofore, furnished more than half of the recovered product, both in respect to amount and value; New Hampshire approximately one-fifth; Georgia about one-tenth. Precise figures of production during 1919 and 1920, are not as yet available. Of the states named, and from such data as has been obtainable, it seems indicated however, that North Carolina and New Hampshire have about maintained their annual average, Georgia under war stimulus, having shown a marked and surprising increase, notably in the Thomaston district. It has been recently stated by Mr. Courtenay DeKalb and others familiar with recent Georgia developments that its record-breaking war period increase in output can be maintained, and that it is capable of being made one of the largest of the mica producing states. Virginia, in 1918, practically doubled its 1917 production. Alabama's output showed a decline, and South Dakota, South Carolina, and Idaho, no appreciable production, as was the case also with Colorado and Wyoming.

Among the minor producing states, a possibly important increase in production, having some distinct possibilities, is reported during 1920 from New Mexico, where in the Petaco District the El Paso Mining Company, operating mines in Rio Arriba County, developed a pegmatite body, (stated to be unusually wide and persistently micaized) by some 1,000 feet of drifts, recovering therefrom mica of fair sizes and of good quality in amounts not stated, as the output of the mines has been altogether manufactured into specialties by the operating company. Outside of the ten producing states from which recognized production has heretofore been drawn, mica occurrences, undeveloped, and therefore of no present known import-

ance or value, have been noted in an equal number of other states.

World production is altogether compiled and stated on the sheet mica basis, for the reason that outside of the United States, and in lesser degree Canada, the mica recovered, being almost altogether exported to some point of manufacture, is clear sheet of good quality.

In domestic production, no information is available for comparison as to the precise amounts of such clear sheet, owing to the fact that compiled statistics; which must necessarily base upon such incomplete returns as mine operators can be induced to furnish, make no separation in amount in most cases between the various grades of clear, defective, cut and uncut, punch, washer, and run-of-mine, the gross amounts only being obtainable as reported.

In the report of the U. S. Geological Survey on Mica in 1918 by Waldemar T. Schaller, from which the statistical and other data here given are largely quoted, compiled statistics have received a most comprehensive and instructive analysis, in which upon an assumed (but indicated as proven) basis, of a yield of one pound of cut mica to every three pounds of uncut, the total production for 1918 of uncut mica larger than punch, would approximate 700,000 pounds.

An instructive and valuable determination by analysis of the actual percentages of the different sizes of uncut sheet mica entering into the above stated figure of total production, is also made by Mr. Schaller in this 1918 report, based upon an available aggregate amount of 150,000 pounds on which precise and accurate data had been reported, these percentages applying only to uncut sheet larger than punch, and working out as follows: 1½ by 2 inches, 31 per cent; 2 by 2 inches, 25 per cent; 2 by 3 inches, 23 per cent; 3 by 3 inches, 8 per cent; 3 by 4 inches, 5 per cent; and of larger sizes, 8 per cent.

Applying the percentages by sizes so obtained to the estimated total production of uncut sheet, inclusive of uncut punch, and reducing all cut mica to its approximate equivalent (three times), of uncut mica, the following important tables are further deduced by Mr. Schaller,

which will serve to show as to relative sizes the possibly fair averages of sizes actually realized in most domestic mine operations.

Estimated production of Sheet Mica in the United States in 1918, by sizes.

	Pounds.
Punch	1,175,000
1½ by 2 inches.....	217,000
2 by 2 inches.....	175,000
2 by 3 inches.....	161,000
3 by 3 inches.....	56,000
3 by 4 inches.....	35,000
Larger sizes	56,000
Splittings	11,000
	<hr/> 1,886,000

The percentage yield of cut mica according to use, applied to the 700,000 pounds of estimated production of uncut sheet mica larger than punch, would represent approximately the following yield of domestic cut mica for 1918:

Approximate yield of cut mica larger than punch in the United States in 1918.

	Pounds.
Cut condenser mica.....	91,000
Cut electric mica.....	84,000
Cut stove mica.....	28,000
Other cut mica.....	21,000
Scrap from cutting.....	476,000
	<hr/> 700,000

These quantities would represent a maximum, as the 700,000 pounds of mica include the 1½ by 2 inch size, (too small for condenser mica), and include also all grades from the clear, to the heavily stained and spotted. The 91,000 pounds of condenser mica, may therefore be taken as the approximate maximum annual quantity of that grade that this country could produce under 1918 conditions. It is easy to see that the domestic mica was not then sufficient to supply the demand for condenser mica, which amounted to many hundred thousand pounds in 1918, and was expected to be nearly a million pounds in 1919, if the military program had continued in full force.

STOCKS.

With the exception of splittings, the domestic consumption of which is almost altogether imported, practically no sheet mica stocks whatever are held in this country which could be at all regarded in the nature of reserves, the small stocks accumulated being only sufficient in a general way to provide for fluctuating market requirements.

CONSUMPTION.

Briefly summarized, the detailed figures of consumption compiled by the U. S. Geological Survey conclusively show that the world's annual consumption and production virtually balance, there being little or no recovery of used mica, and practically all mica mined being consumed.

The percentage of world's production represented by consumption of sheet mica in the United States from 1910 to 1917 inclusive, is stated at 48¾ per cent. The annual consumption of sheet mica in the United States, is approximately stated at present as 1700 short tons, less than half of which is domestic output, by far the larger part of the imported remainder being splittings.

Expressed in percentages as to its uses; of the domestic uncut sheet mica mined in all sizes, 71 per cent has been utilized for electric insulation, 23 per cent for stove fronts, 2 per cent for phonograph disks, and 4 per cent. for other purposes. Of the imported uncut muscovite sheets, exclusive of splittings, 82 per cent. has been consumed for electrical insulation, 5 per cent. for stove fronts, 6 per cent. for phonograph disks, 4 per cent. for lamp chimneys and canopies, and the remaining 3 per cent. for other uses.

These estimates of relative percentages as deduced by the United States Geological Survey indicate that about 45 per cent. of the total uncut sheet (excluding splittings) is finally used in the finished form, the remaining 55 per cent becoming only scrap suitable for grinding. As also stated by Mr. Schaller, normal world's consumption of sheet mica (inclusive of splittings) prior to 1914, had

been estimated to be 7,000,000 pounds, or 3,500 short tons, of which amount the United States consumed 1700; Germany, 800; Great Britain, 400; India, 400; France, 100; Italy, 50; and all other countries 50 short tons under approximately normal conditions obtaining during the period indicated. Present consumption when known will reflect the increase due to the large and continuously world wide expansion of the electrical industry.

No reliable figures have ever been available as to the total amounts of world's consumption of mica splittings, which in 1919 was estimated as being 1111 short tons, of which aggregate estimate, India is stated as utilizing 663; Canada, 376; and the United States only 72 short tons.

No accurate figures showing the actual consumption of scrap and of ground mica are available, either of world utilization, or in the United States, the actual consumption being greater than is recorded by reason of the increment derived from mica trimming, entering into the estimates of mica production as uncut mica.

*From 1910 to 1918 inclusive, the estimated annual average amount of ground and scrap mica consumed in the United States was 4401 short tons, the average annual production for the same period being 3774 short tons.

Classified as to its uses, the relative percentages of ground mica sold in the United States for various purposes in 1918 (the quantity sold being 50 per cent. in excess of the reported production), were as follows:

Patent roofing	60
Wall paper	21
Manufacture of automobile tires.....	8
Fancy paints, concrete facing, Christmas tree "snow".....	3
Molded electric insulation.....	3
Annealing, filler for rubber goods (other than tires), printing lithography, sizing cotton, etc.....	3
Lubrication, oils, greases and metal bearings.....	2

100

*U. S. Geological Survey Mica in 1918.

VALUE.

Statistical information relative to the value of the mica recovered necessarily bases upon an average valuation; which, owing to the wide range of the various grades produced, does not correctly reflect or indicate actual values.

As estimated and stated by the United States Geological Survey, the ratio in this country of finished trimmed sheets from the rough block varies widely, ranging from 2 to 33 per cent., a possibly fair average being 10 per cent. for such finished sheet recovery.

As in the making of official returns for the compilation of statistics, the various commercial grades of sheet mica, cut and uncut, run-of-mine, punch and washer, clear, and slightly stained, iron spotted, flawed and without defect; presenting the most extreme variations in market value, are very commonly lumped together, the incorrectness and unsatisfactory character of estimates based on average mica values necessarily so obtained is clearly evident.

Official figures of valuation compiled under the disadvantages stated, and ending with the year 1918, show that in that year as compared with ruling prices during 1917, prices realized were 27 per cent higher for punch; 38 per cent. higher for 1½ by 2 inches; 29 per cent. higher for 2 by 2 inches; 18 per cent. higher for 2 by 3 inches; 13 per cent higher for 3 by 3 inches; and 10 per cent. higher for larger sizes.

The average prices realized for sheet mica in 1918 on domestic output so comprehensively obtained and officially stated, was 45 cents per pound, but was materially influenced by the war basis of price fixing, effective by England in July, and by the United States War Board in October of that year, under the then existing war conditions.

The following table reflects prices ruling from 1913 to 1918 on the average return of valuation basis.

**Average prices per pound paid in the South for rough-trimmed sheet mica of good quality, split and sorted to cut the sizes indicated, 1913-1918.*

Size (in inches)	1913	1914	1915	1916	1917	1918
Punch	\$ 0.035	\$ 0.03	\$ 0.04	\$ 0.05	\$ 0.055	\$ 0.07
1½ by 2 .....	.12	.10	.20	.30	.40	.55
2 by 2 .....	.30	.25	.40	.55	.70	.90
2 by 3 .....	.70	.65	.70	.90	1.10	1.30
3 by 3	1.15	1.00	1.00	1.35	1.55	1.75
3 by 4	1.35	1.20	1.25	1.70	1.85	2.05
3 by 5	1.70	1.50	1.50	1.95	2.15	2.45
4 by 6	2.25	2.00	2.10	2.85	3.10	3.45
6 by 6	3.00	2.70	2.80	3.50	3.80	3.90
6 by 8	4.00	3.60	3.50	5.00	4.70	6.00
8 by 10	6.00	5.40	5.20	7.50	7.50	8.00

*U. S. Geological Survey Mica in 1918.

The preceding table as noted above to some extent is influenced by war conditions and governmental price fixing. The continued post-war demand for mica by the electrical industries, has however not only maintained the higher level of war prices, but has even resulted in a material increase of these prices, extending to all grades, and amounting as estimated to approximately 25 per cent. or more for special grades most actively in demand. Analysis of these advances in value also indicates that they base largely upon the smaller sizes of mica, the most marked increase in prices paid per unit area, being for 2 by 3, and for 3 by 4 inch. As reflecting active preferential market conditions and demands for these smaller sizes, which must necessarily constitute the major part of the output of most if not all mica mines, these facts, if correctly understood and construed, are of material benefit and importance to the mica miner. Largely increased use of condenser mica also entered into these and present price advances. Among special war demands influencing 1918 prices the largest sizes, grades 1, 2, and 3 were required for spark plugs for the Aircraft Production Board, used in Liberty motors; grade 4 was specified for radio condensers, for both navy and signal corps radio apparatus; grade 5 being used for magneto condensers for the

motor transport service, and the smallest size, 6, being also used for spark plugs.

Present market quotations as of date January 1921 which may be taken as an approximate index of the present values of the various grades, both foreign and domestic, when prepared in accordance with ruling market specifications ranged about as follows:

*India block mica, slightly stained, per pound, No. 6, 50 cents; No. 5, \$1.20 @ \$1.40; No. 4, \$2.50 @ \$3.00; No. 3, \$3.50 @ \$4.00; No. 2, \$4.50 @ \$6.00; No. 1, \$5.50 @ \$6.50. Clear block, No. 6, 50c; No. 5, \$1.75; No. 4, \$3.25; No. 3, \$5.00; No. 2, \$6.50; No. 1, \$8.00; A1, \$6.50 @ \$8.50; extra large, \$25.00; all f. o. b. New York. Ground \$150.00 per ton Phila. Domestic uncut f. o. b. Franklin, North Carolina: scrap \$45.00 to \$50.00 per ton; punch 10 cents per pound; circle 15 to 25 cents; 1½ by 2 inch, 75 cents; 2 by 2 inch, \$1.15; 2 by 3 inch, \$1.65; 3 by 3 inch, \$2.10; 3 by 4 inch, \$2.50; 3 by 5 inch, \$2.75; 3 by 6 inch, \$3.75; ground 165 mesh, \$150.00 to \$170.00 per ton; ground roofing mica, \$60.00; mica washers, 75 cents to \$2.00 per pound. 1¼ inch disks: Number 1, \$1.40; No. 2, \$1.25 per pound. The foregoing domestic prices obtaining also in the Chicago district.

Prices paid for Alabama cut sheet local average grade, being spotted, and carrying some mineral inclusions were during the closing period of 1920 as follows: 1¼ by 5½ inches, per pound \$3.50; 2 by 3, \$2.50; 2½ by 4¾, \$2.50; 2½ by 3, \$2.75; 2½ by 3½, \$3.00; 3 by 3, \$3.50; 3½ by 3½, \$4.00; 1¼ by 5½, \$3.50; 2¾ by 5½, \$4.10; 1½ by 8, \$5.00.

IMPORTS AND EXPORTS.

The sheet mica including splittings imported for consumption in the United States during 1918, as reported by the Bureau of Foreign and Domestic Commerce, was valued at \$1,539,482, the highest value recorded by the United States Geological Survey. In 1918 there were also imported 6 tons of ground mica valued at \$1,647.

*Engineering & Mining Record.

During the war years, imports of mica were received chiefly from England, Canada, India, Brazil and Argentina.

Exports mainly of manufactured products, were in 1918 as usually very widely distributed, being world-wide. During the year 1919, imports of crude mica showed an increase over 1918 of about 18 per cent. in amount and of over 20 per cent. in value, the stated increase being in part attributable to larger importations of the higher grades, as a decline of approximately 25 per cent. was noted in the value of cut mica importations for the same period.

Exports during the year 1919 were in excess of the amounts estimated as exported during the preceding year.

*During the first nine months of 1920, the mine industry in the United States was prosperous, but suffered severely from the general industrial decline during the last quarter of the year, which was marked by the falling off of market demands, and by unusual accumulations of surplus stocks, prices dropping in consequence from 10 to 20 per cent. in the various grades.

Importations of mica increased in 1920, reaching in the first ten months of the year 1,375,927 pounds of uncut mica, valued at \$1,206,443, or nearly double that of the corresponding period of 1919. Cut mica was imported to the value of \$1,656,182 in the same period.

Exports of mica during the first ten-month period of 1920, were valued at \$243,381, about 10 per cent. of the value of imports.

The gradual resumption of industrial activity thus far during 1921, would not seem to indicate any possible increase of production during the present year, and it is doubtful whether the 1920 output will be at all equaled, the mica industry in North Carolina and in Georgia being at the present time virtually stagnated.

OCCURRENCE.

Mica deposits of commercial value or importance in Alabama and elsewhere, are located altogether in the

*Prof. J. Volney Lewis in Engineering and Mining Record Annual Review Number, Jan. 22, 1921.

pegmatites, which are formations similar to granite in chemical and in mineral composition but coarser in texture, their aggregate, made up of quartz, feldspar, and mica; varying widely in the relative percentages of these constituent elements, as well as in the coarseness or fineness of their combination.

In the zone of weathering or within the limits of surface decomposition, the feldspar in the pegmatites has been in many localities either wholly or partially kaolinized.

The surrounding rocks, mainly of igneous and of metamorphic origin and probably of Archean age, are largely made up of the constituent elements; mica, garnet, cyanite, and hornblende, being commonly granite gneisses and schists, with occasional accompaniment or association also of the soapstones and serpentines.

The comparative regularity of the structural features of the enclosing gneisses and schists, to which in large measure the pegmatite lenses or bodies lie in conformity, tends to render them also more or less persistent in length along the strike, and often to considerable depth on the dip, although presenting wide irregularities in shape and form and variable in section as to width; tapering, widening and frequently as lenticular bodies overlapping. It is not uncommon to find them however as distinctly cross formations.

In the hornblendic areas, occurring at the extreme southwestern end of the Alabama mica field, the pegmatites are uniformly made up of a quartz and feldspar aggregate in small fragments or particles frequently carrying good flat muscovite mica of high grade, but generally speaking in sizes too small to be worth recovering, the mica occurring largely in the kaolinized feldspars.

Generally speaking, the irregular masses, lenses, streaks, and bodies, of pegmatite occurring in Alabama, present extreme variations in thickness, ranging from a few inches to fifty feet or more.

The quartz of the segregations is massive, usually granular, frequently crystalline, and uniformly persistent throughout the mass. Feldspar, usually either orth-

oclase or microcline, occurs in masses or distributed throughout the aggregate in variable amounts.

The occurrence or position of mica in the pegmatites also varies widely. In the granular masses, of finer texture, it is often quite uniformly distributed throughout the aggregate, and is therefore of small size although of good quality.

In the pegmatites of coarser texture, the mica crystals and masses are commonly found in concentration along the contact with either the foot or the hanging walls, partially plated or bedded on or in the wall rock, and collected around the edges of inclusions of horses, which are composed mainly of quartz, lying wholly within the pegmatite. Thin, and more than usually persistent bodies of pegmatite, schist-walled, giving them the appearance of veins, frequently carry highly concentrated mica inclusions, as is notably the case in certain deposits developed near Dadeville in Tallapoosa County, Alabama.

Horses, or wall-rock intrusions, are a very general and disturbing feature of practically all the pegmatite deposits of the State, complicating methods of mica mine recovery with attendant increase of mine cost. Their occurrence has a wide range of irregularity, both as to size or bulk, and in respect to conformity or non-conformity with the foot and hanging walls.

Mica, of what is commonly called A-form, or A-structure, is of frequent occurrence in Alabama as elsewhere, being usually found in masses, often of large size, but in such irregular shaped and distorted blocks as to be of small commercial value except for grinding, although small amounts of good flat sheet mica is to some extent recoverable near the centre of some of these blocks by splitting. Among mica miners, opinion varies widely as to whether or not a heavy surface capping of A-form mica may be taken as a reliable indication of an underlying deposit of flat mica, at a depth, and under conditions, favoring more perfect crystallization. As a matter of fact, variable amounts of good flat mica occur in the Alabama field co-existent with the A-form masses, and in some instances observed and studied, there is indicated a decided and possible change from A-form to altogether other and fav-

orable forms of more perfect crystallization at greater depth, usually below water level. Masses however of mica of A-structure, in Clay County, Alabama, have in contradistinction, been taken out at a depth below water level, in direct association with considerable amounts of flat sheet mica of high grade. In close proximity to these variable deposits, following the well defined strike of apparently the same pegmatite leads, no A-form mica whatever occurs, and there has been recovered some of the finest and largest muscovite ever found in the United States, running in the lower entries of the mine up to sizes approximating 12 by 18 inches, of smooth flat sheet, almost wholly free from imperfections.

By reason of its marked resistance to ordinary weathering and resultant decomposition, mica is very generally of surface occurrence along the outcrops of pegmatite, enabling them to be readily traced up and developed. Decomposition of, or alteration in, mica crystals or blocks on or near the surface, however, varies somewhat, being governed by their hardness and associations. Thus open and clay-stained blocks, are commonly found extending to variable and often considerable depths under cultivated areas of long standing, while in or on outcrops of quartz, of pegmatite aggregates, crystals not infrequently occur, sound, unaltered, and free from imperfections, directly on the surface.

PROPERTIES AND CHARACTERISTICS.

In its application to the industries, mica, by reason of its more or less perfect cleavage, flexibility, elasticity, toughness, semi or perfect transparency, non-conductivity of heat and of electricity, and comparative resistance to decomposition, possesses qualities not shared by any other mineral product. The immense and constantly expanding growth of the electrical industry has been largely due to and dependent on the use of mica insulation, for which mica is indispensable and has no adequate substitute. Its necessary use in condensers, has recently been the means of radical changes and large economies in wireless telegraphy.

Muscovite has a specific gravity of 2.8 and is therefore heavier than its associations of quartz and feldspar.

In hardness, the various varieties and to some extent the same varieties of mica, vary somewhat, scaling in the Alabama field at approximately 2.5 or about that of copper, although frequently slightly softer. A close approximation in hardness to copper is material to the value of electrical mica in generators, as affording equal wear and the consequent absence of sparking in commutators of direct-current motors and dynamos, built up of copper bars and mica strips, for which purpose, and for the above stated reason, Canadian phlogopite receives the preference. The hardest mica recovered in Alabama is of the green variety of muscovite.

The structural characteristics and forms of mica are minutely and exhaustively described and illustrated in Bulletin 430-J of the United States Geological Survey by D. B. Sterritt and H. J. Gale, from which report, the following descriptions and explanations are literally quoted.

Muscovite, like all the micas, belongs to the monoclinic system of crystallization, and has a symmetry approximating the hexagonal. This symmetry is indicated by the nearly hexagonal outline often observed in the prisms by the percussion and pressure figures, and by "ruled" and "A" mica as described below. Mica mined for commercial purposes is generally found in rough blocks, sometimes with an irregular development of crystal faces. The faces are not usually as many as would be required to complete the simplest figure, and their surfaces are generally very rough. Very commonly a large part, if not all of a block of mica has a ragged outline without plane surfaces. Occasionally fairly well developed hexagonal or rhombic prisms are observed in crystals weighing hundreds of pounds.

Rough crystals, or "books" of mica as they are called in the Western States, do not split perfectly until the outer shell of etched and sometimes partly crushed mica has been removed. This is accomplished by rough splitting, or cleaving the large book into sheets one-eighth inch thick or less, and trimming the edges with a knife held at a small angle with the cleavage. Further split-

ting is then easy, because the cleavage of mica is so perfect and the tangled outside edges of the sheet have been removed. By grinding a wedge edge on the sheets and using a thin sharp knife, mica can be readily split into sheets as thin as one-thousandth of an inch or thinner.

As classified by physical peculiarities of crystalline structure, color, and inclusions, mica is commonly known to and spoken of by mica miners as "ruled" or "ribbon," "wedge," "A-form," "hair-lined," "fish bone," and "tangle-sheet." "Specked" or "clay-stained" mica, refers to mineral or clay inclusions in closed or open books. "Ruled" or "ribbon" mica, is formed by sharp parting planes cutting through the mica crystals at an approximate angle of 60 degrees with the base or cleavage surface, extending either through, or partially through, the crystal.

Ruling lines however usually occur in closely parallel formation, and while dividing the crystals into smaller, inconveniently shaped and less valuable and recoverable sizes, the grade of mica constituting the ruled portions, is quite uniformly good, constituting the best part of the crystal. No deposits of mica of any magnitude in the State have been examined which do not show ruled mica to greater or less degree, and in certain deposits it may be said to predominate. The physical term "wedge" mica, is of obvious meaning and refers to masses of varying thickness on the edges, due to unequal crystalline development.

A-form, or A-structure mica, called by miners "horse-tail," carries a double series of lines or striations forming with each other an approximate angle of 60 degrees, from which characteristic its name is derived.

In "fish-bone" or "herring-bone" structures so-called, the striations form with each other an approximate angle of 120 degrees, meeting along the center line of the crystal.

"Tangle-sheet" is the trade and mining term used to describe mica in which the laminae are so formed as to split properly only in certain portions of the block, mainly around the edges. "Specked" mica contains inclusions of iron oxide or of other minerals with consequent reduction in grade and value. It is not of general occurrence

in the Alabama mica field, but is found in some of the present operating mines.

In respect to color, muscovite is broadly termed "white" mica, although in the thin sheet it may present wide variations in shade, ranging from almost clear white to amber, yellow, green, brown and brownish-red, and darker red or "ruby."

Phlogopite, in the thin sheet, is of a yellowish or brownish color, deepening in the thicker sheet to yellow, brown, copper colored and verging on black. Color variations appear to be closely related to variations in hardness, elasticity, and dielectric quality.

In the matter of flexibility, a sheet of good muscovite a thousandth of an inch in thickness, should be capable of being bent into cylindrical form of $\frac{1}{4}$ inch diameter without evidence of cracking.

USES.

*The uses of mica may be summarized as follows, the classification being based on the physical property of greatest importance.

Electric insulation: Sheets, films, mica board, washers, mica cloth, and tape; for dynamos, condensers, telephones, light sockets, spark plugs, and innumerable other electric appliances. Ground mica, mixed with shellac, is molded into various insulating forms.

Heat insulation: Screens in front of highly heated material, as retarder of heat waves in optical lanterns, and in electrical heating devices. Ground mica is used as pipe and boiler coverings, in annealing steel, and in fire-proof paints and coverings.

Transparency: Glazing the fronts of stoves, for furnace sight holes, lamp chimneys, lamp shades, military lanterns, lantern slides, sight holes of diver's helmets, compass covers, gage fronts, in windows where glass would be broken by heavy shocks or vibrations, and as coverings for wounds.

Resonance: Phonograph diaphragms and various sounding devices (submarine detectors).

*U. S. Geological Survey Mica in 1918.

Decoration: Sheets of mica form the material on which pictures and portraits are painted and for inlay work. Ground mica is used extensively for decoration in wall paper, processional ornaments, fancy paints, ornamental tiles, and concrete.

Lubrication: For wooden and metal bearings and for tire powder.

Filler: Patent roofing material, rubber goods, buttons, absorbent for nitro-glycerine, and various other products.

Miscellaneous: Calico printing, to prevent sticking of tar papers, medicinal uses (India only) etc.

*A recent classification of these uses of mica, based on their relative importance, is as follows:

Essential uses: Electrical insulation—films, sheets, washers, splittings, and built-up mica board.

Less essential uses: Stove front, lamp chimney and shades, electric heating devices, pipe and boiler coverings, roofing material, annealing steel, lubricant for wooden bearings.

Non-essential uses: Phonograph diaphragms, decoration, lubricant for metal bearings, filler for rubber and various materials.

Consumption of mica by the industries would largely base as to relative amounts, although not necessarily in respect to prices paid, on the above classification of uses.

Commercially speaking, splittings refer to sheets approximately about one thousandth of an inch in thickness, which thin sheets are manufactured by special processes into molded and built up forms variously known to the trade as micanite, micabeston, micabond, micademite and others, used extensively for electrical insulation.

Sheet mica finds its uses as above indicated in all three of the classes of essential, less essential and non-essential uses, and constitutes the most important and largest part of the mica industry. As commercially prepared, it ranges in sizes from what is known as punch mica, for the manufacture of disks and washers of at least $1\frac{1}{2}$ inches in diameter, on up to the largest sheet

*U. S. Bureau of Mines Mica in 1918.

recoverable with proportional values based on size, condition, and properties.

The chief use and largest consumption of sheet mica is for electrical insulation. For use in high-potential machinery or appliances, only high-grade sheet mica, wholly free from imperfections in the form of cracks, pin-holes or inclusions is rigidly specified.

Originally, sheet mica found its principal and almost sole use in glazing, for stove windows and for certain forms of lamp chimneys. Although still necessarily in use for these purposes and commanding increasingly high prices for the grade and sizes of sheet required, the amount so used at the present time is hardly one-tenth of the sum total of consumption, which has been estimated to average: for electrical insulation, splittings, 40 per cent, and sheet 46 per cent., or a total for electrical insulation of 86 per cent.; stove glazing 10 per cent., phonograph diaphragms 2 per cent., the remaining 2 per cent. covering all other purposes.

The following table indicates, as to size, the various grades upon which market quotations usually base:

<i>Trade Number</i>	<i>Size in Sq. Inches.</i>
Extra Special	60 and up
A.A.	48 to 60
A1.	36 to 48
1.	24 to 36
2.	15 to 24
3.	10 to 15
4.	6 to 10
5.	3 to 6
6.	— to 3

During the late war, an entirely new use developed for sheet mica in surgery as a covering for open wounds under treatment, by reason of its transparency, its anti-septic quality, because of absolute freedom from corrosion, and its value as a non-conductor of heat and of cold, plates of mica being included to some extent in first aid kits used in the field.

Ground mica, aside from its former chief uses in patent roofing, in the annealing of steel, in various forms of lubrication and for fancy paints, tiles, and concretes, for

boiler coverings and fire-proof paints, has recently developed increasingly a new application to the rubber-tire industry, as a tire ingredient, and as a powder for inner tubes. It has long been utilized as a powder to prevent adhesion in rolls of rubber belting, rubber or rubberoid roofing and similar materials. For use in the rubber-tire industry, new methods of grinding and of preparation were requisite in order to obtain the necessary fineness and freedom from any deleterious admixture.

Limited information only is available as to the methods little patented and largely kept secret, which have been so far most successful in producing the required rubber product. They mainly classify as first, disintegration by heating; second, abrasion with mill-stones or burrs; and third, by baking at intense heat followed by pulverization under a steam or air blast. Products ranging from 8 to 200 mesh are subsequently made after grinding, on vibrating screens. Ground mica so prepared, has been marketed at prices which have been found very satisfactory and profitable.

Should ground mica so prepared become a fairly universally used material as a filler in the rubber tire production of the United States, already estimated to have reached a figure in excess of 50 million tires per year, a very substantial increment in the value and use of what is now largely as scrap, a low priced or altogether waste product in mica production, is substantially indicated. While for this purpose it has been found superior to the filler hitherto in use, to which it has proved to be of more value and utility by reason of its special qualities, ground mica, for other and its ordinary uses, is the only form of mica for which a satisfactory substitute has been successfully found and commercially used. For electrical mica in its special forms there is no known substitute.

From its physical characteristics, the grinding of scrap mica or its first preliminary disintegration, is a difficult operation for reasons which are self-evident. Numberless methods have been tried, and where successful, have been as far as possible kept secret. The most satisfactory results have apparently been obtained by the use of various special forms of conical wooden rollers. The

highest grades of "rubber mica," acceptably prepared under commercial specifications, are stated to have been marketed at prices ranging from \$180.00 to as high as \$300.00 per ton.

COMMERCIAL GRADES AND SPECIFICATIONS.

As known to the trade and the manufacturer, commercial mica is of three general classes designated as run-of-mine, sheet, and scrap.

Run-of-mine mica; as the name implies, refers to mica in its crude recovered condition, precisely as it comes from the mine, viz: in rough blocks or masses, with their rock edges adhering to them, and of all sizes and grades; their subsequent sheet values having not been as yet determined or being reliably indicated.

For this obvious reason, the prices offered and commonly paid for mine-run block are necessarily low, and do not as a rule represent a fair basis of compensation to the miner, as the skilled manufacturer, accustomed to working up such rough block, is better able to approximate its possibilities than any miner lacking this experience and knowledge. A very large percentage of the domestic mica mined both in the West and in the South, has in the past been disposed of on this basis, with resultant disadvantages and discouragement to the miner.

This condition, requiring only special knowledge and a reasonably small amount of necessary and added mine equipment for its abatement, has had a marked effect in limitation of mine output, many small operations having been abandoned in consequence of such low prices received which would have been otherwise remunerative. The reverse condition, is one of the causes of uniform success in the India mica field.

Sheet mica, as known to the trade; is defined and classified by its physical preparation and condition, and by its adaptability to its various uses and its value therefor.

The general trade definition of sheet mica refers to split sheets of approximately one-sixteenth inch in thickness, more or less properly trimmed or edged. By far the largest part of the domestic mica marketed, is im-

properly prepared, with resultant loss to the producer, being either "rough-trimmed," or "thumb-trimmed," and only partially edged.

"Thumb-trimmed" mica is the term used to describe mica blocks or books having the rock edging in part crudely removed by hand separation or breaking off. "Rough-trimmed" mica, represents a slightly better stage of preparation, and "knife-trimmed," its competent and proper form, all edging imperfections being removed, and the physical condition of the sheet for subsequent handling and shipment being as far as possible perfected.

*Sheet mica is also classified according to its uses. Condenser mica must be clear ruby, colorless or greenish, must be split easily and smoothly into films as thin as one-thousandth of an inch, must be free from cracks, holes, foreign substances, stains, spots, smoke, and sheets must be plain and smooth, free from waves, wrinkles, reeves, rulings, or knots. Uncut condenser mica, to cut any particular size, must not be larger than one and one-half times that size each way. Cut but not split condenser mica is cut into regular sizes, 2 by 2 or 2 by 3 inches, which are slightly larger than the thin sheet actually used in the condensers. From this cut mica the condenser film is then punched out in the shape and size used. If cut and split, the individual pieces are from 0.001 to 0.003 inch thick, with an allowable variation of only 0.0005 inch. If cut or punched into the required shape, split to the necessary thinness, and carefully inspected, the mica is called condenser film mica. The cut edges of the films must be smooth, and the finished film must of course be free from all defects and cracks. For wireless outfits, each film must withstand 20,000 volts. For magneto condensers, no high-voltage resisting test has to be made, but each film must be free from cracks or other defects. Such "film mica" is very different from the thin splittings used in the manufacture of mica board. These irregular-shaped splittings are sometimes also called films. It has been estimated that on an average it takes from 2 to 3 pounds of trimmed Indian or cut

*U. S. Geological Survey Mica in 1918.

domestic mica (or double the quantity of uncut mica), to yield 1000 acceptable condenser films. By careful selection it has been possible to obtain a pound of cut films from 5 to 6 pounds of domestic uncut sheet mica.

Phonograph or diaphragm mica is also a variety of very high grade. It must be free from all imperfections, such as rulings, cracks, and inclusions of other minerals, must split well and evenly, must be clear and transparent, and must also be flat, this last feature being an essential character of diaphragm mica. Mica for lamp chimneys and canopies must be clear, split easily, and be extremely flexible. Very little domestic mica is so used.

For stove glazing, a hard rigid mica is preferred, as nearly clear as possible. The greenish North Carolina mica receives the preference for this purpose.

Splittings, commercially speaking, are very thin sheets, approximately one thousandth of an inch in thickness, may be irregular in shape and size, and may contain some flaws or imperfections. They are altogether prepared by hand, most of the large India preparation of splittings being made by women and children, a long thumb nail being there largely used in preference to a knife for this purpose. From 2 to 4 pounds per day of splittings represents an average production. A variable amount of domestic splittings accumulates necessarily in the working up of mine-run mica and in the general handling of cut and uncut sheet into specific forms.

The otherwise waste product of the mine in the form of mica recovered having no sheet value, and the waste resulting from the cutting, trimming and preparation of sheet mica, etc., collectively classes as scrap, which as sold and utilized for grinding may have, and usually contains inclusions of various kinds, mainly quartz and feldspar.

ASSOCIATIONS.

The useful associated minerals of the pegmatites in Alabama, of possible value as by-products, recovered necessarily in the ordinary course of mica mining, are kaolin, feldspar, and quartz; stated in the order of their ordinary commercial importance.

The feldspar group occurring with the mica deposits, mainly potash spars, with resultant kaolins are taken out to greater or less extent in all mica recoveries, but have received as yet in Alabama only limited tests and no appreciable commercial use. From 20 to 40 per cent. of ground feldspar enters into the composition of most china and porcelain, as a bonding and dissolving medium of the kaolin, ball clay, and ground flint. It has also a wide range of minor uses. As a source of potassium compounds, the potash spars received exhaustive testing during the war, the results of which tests have not yet been fully made known. It has been stated however that under present known methods a minimum of 12 per cent. of potash is requisite for any profitable process for its extraction from spar.

Such high grade feldspar is hardly likely to be obtainable in this State in any large centralized amounts. Analyses made of best native spars have averaged approximately 10 per cent. potash, although the samples tested would otherwise class as No. 1 by reason of freedom from iron bearing minerals, and as containing but little muscovite and quartz, an allowable 25 per cent. of quartz being permissible in No. 2 spar grade.

The most important and valuable use of this mineral would be its possible local value as ground feldspar for a commercial fertilizer. The availability of potash in finely ground feldspar has long been the subject of exhaustive practical tests, the results of which tests have been conflicting under varying soil conditions. Tests however under special conditions, made by the U. S. Bureau of Plant Industry, representing the wide variance of soils presented by Connecticut and Florida, have demonstrated that plants were able to obtain potash from very finely ground feldspar. If such availability becomes fairly assured through continued and systematic experimentation Alabama spars may become of very positive value.

Crystalline quartz, of certain specified grades, has various commercial uses. For acid towers, the sizes specified are termed "fist" to "head."

Ground quartz finds its application in the manufacture of sand-paper, sand belts, and in sand-blast apparatus for frosting glass. It is also one of the constituents with feldspar and kaolin of pottery and glaze mixtures. In copper smelting, it is used as a flux. Finely ground it finds its application to some extent for filters, and in acid proof cements; as a wood filler, and in scouring and cleaning preparations, and paints.

The commercial value of the crude product ranges from 80 cents to \$3.50 per ton, and from \$6.50 to \$20.00 per ton for ground quartz of various degrees of fineness.

The kaolins, resulting from the decomposition of the potash spars in the mica bearing pegmatites, constitute a very considerable part of the dead material necessarily removed in the recovery of mica. Competent expert tests made at Trenton, New Jersey potteries on certain Alabama kaolins occurring in the mica pegmatites, have proved them to be of superior quality for use in porcelain manufacture. A detailed statement of these tests, and of the values indicated, will be found under the head of kaolin.

The above facts relative to the uses and approximate commercial values of the pegmatite minerals other than mica, are given as of possible and material bearing on the question of by-product recovery in mica mine operation; being an available means of possibly reducing mine cost by their utilization.

Statistics of recently augmented mica output, have clearly indicated that by-product recovery has been to a considerable extent an important and increasing factor in such augmented production. Hydro-electric power is now in the Alabama mica field at certain points available and will in the near future become increasingly so for economically grinding scrap as also the above named mica by-products requiring pulverization into acceptable and salable commercial forms and grades.

As a positive mineral value, directly and indirectly associated with the mica pegmatites of Alabama, gold may prove of material and definite importance.

The original exploitation of mica in this State and its first attempted commercial development, was located at

Pinetucky in Randolph County, where in the early "seventies" a number of shafts and tunnels were opened up on this property, and considerable amounts of mica of large sizes were recovered and sold. It was however discovered by the operators that the quartz of the pegmatites was frequently rich in gold, and the mica recovery became secondary to gold mining, later on being altogether abandoned in favor of mine and mill recovery of the gold values carried in this mica mine.

During the subsequent period of such operation by the Alabama Gold Belt Mining Company, the Pinetucky mine was in 1897 examined by Mr. W. M. Brewer, then Assistant Geologist of the Alabama Geological Survey, who reported very rich free gold occurrences on the fifty-five foot level. Assays of gold-bearing quartz from the Pinetucky mine are stated by Mr. Brewer to have frequently run in free gold, irrespective of the sulphurets, from \$150.00 to \$200.00 per ton. In this immediate district, which is now receiving extensive mica development, it is stated by Mr. Sam Wallace, the present owner of the Pinetucky mine and mill, that the quartz of the mica pegmatites very generally carries free milling gold values, which may to some extent be economically recoverable as the district develops, the formation of a natural water power closely adjacent for the operation of stamp mills being among the possible development factors. A more detailed description of the Pinetucky Mica Mine will be found under the heading of individual mine operations.

An occurrence of tin in the form of cassiterite has also been noted by occasional float ore at various points along the Mica Belt. No systematic attempts have, however, been as yet made to trace this ore to origin, and it is hardly likely to occur in commercially recoverable amount. Water worn float of white cassiterite, of the highest grade, has been also occasionally found and noted in close proximity to the mica bearing pegmatites.

DISTRIBUTION OF DEPOSITS.

The occurrences of mica of possible commercial importance in Alabama are comprised altogether within

the lines of demarkation of the igneous and metamorphic rocks, as shown on the Geological Map of Alabama by Eugene Allen Smith, State Geologist, issued by the Geological Survey of Alabama in 1904. The lines of demarkation referred to and so drawn on this map by Dr. Smith will serve to define and mark out the mica area of the State. Comprised within this area, are all or portions of ten counties, which in the order of their present partially proven and relative importance, are Randolph, Clay, Tallapoosa, Coosa, Cleburne, Chambers, Elmore, Talladega and Lee. The mica pegmatite occurrences are comprised within a number of parallel belts of general northeast to southwest strike, entering Alabama along the Georgia state line, and terminating at various points along the areal limit of the igneous and metamorphic formations. Topographically, the eastern half of the area is traversed from northeast to southwest almost centrally by the Tallapoosa River, the western half being intersected and approximately bordered by the Coosa River, on which included portion of the Coosa is located the present main hydro-electric power plant of the Alabama Power Company, and also the location of the new power plant at the Mitchell Dam now in process of construction in Section 15, Township 21 South, Range 16 East, Coosa-Chilton counties. By these two rivers and their tributaries, the entire area is drained and abundantly watered.

The mica deposits lie at various elevations, ranging from 500 to 1,000 feet above sea level. Some are located upon summits or abrupt slopes, others on plateau or former plateau, and on valley levels and slopes, for the most part carrying fairly light over burden of residual clays. Favorable conditions as to mine drainage are often presented, although in many cases, water level is quickly reached and has presented discouragements. In some of the best and most fully developed deposits however, ideal drainage conditions are available. The level of the ground water encountered necessarily varies widely.

The quality and character of the mica recovered varies in different localities, the variations presented being con-

nected with or attributable to the geologic conditions existing, as for instance proximity to the granites.

Generally speaking, the micas of the same locality and origin are similar and present few differences in characteristics. There are however exceptions to this rule, as in Tallapoosa county, where clear amber muscovite is recovered in close proximity to deposits largely made up of specked and spotted mica, carrying mineral inclusions. It is a notable fact, however, in this connection, that sales made of this particular spotted mica for electrical purposes are stated to have been apparently unaffected by these inclusions, which were not materially reflected in the sale grades and prices realized therefor.

Considered in respect to maximum and definite development, the Alabama mica occurrences might be divided into four major combinations designated as the Dadeville, the Micaville, the Pyriton, and the Rockford groups. As however this group subdivision is of complete occurrence separately in four counties, it will be considered under the general heading of all occurrences in each county.

PART II.

DESCRIPTION OF MINES.

INTRODUCTION.

MICA, in more or less clear sheets, and to some extent of merchantable quality, has been found in every county lying within the crystalline area of Alabama.

Comparatively little actual mining worthy of the name has however as yet been attempted, taking into consideration the possible extent and value of the indicated deposits, such recoveries as have been attempted being largely inexperienced, with limited knowledge therefore of the ordinary peculiarities and characteristics governing mica occurrences; handicapped by insufficient equipment, crude as to methods employed, and quite universally abandoned at water level.

Although the output of some of these mines has been large, and continuously satisfactory, with few exceptions there has been no competent effort made to grade and prepare the accumulated mica stocks recovered in such form as to realize or in fact approximate their actual market value if prepared in accordance with ruling market conditions and specifications. Generally speaking, these stocks have in consequence been disposed of on the run-of-mine basis at low and unprofitable prices.

With practically no scrap or by-product utilization; the earnings of the mines most of them wholly basing in consequence upon some three to ten, or at most, fifteen per cent. of their actual gross tonnage output, and under the crude and unnecessarily costly methods of recovery used, the frequently unprofitable character of the mica industry in Alabama up to the present time is quite easily understandable, and to a very considerable extent, is clearly remediable.

The future successful operation of these mines upon any permanent basis will in large measure depend, (as has been found to be the case elsewhere), upon the proper

handling and utilization of the scrap mica, kaolin, feldspar, quartz, and other by-product recoveries, usually to a large extent wasted, or thrown on the dump, as well as on the experienced grading and working up of the sheet mica into the proper merchantable form requisite for the accumulation of graded stocks, which may then be disposed of at more satisfactory and remunerative prices to the manufacturer, and to some extent, more directly to the ultimate consumer.

Under competent, experienced, and intelligent mining and marketing methods, and provided with reasonable and justifiable mine and shop equipment, requiring a comparatively small invested capital, financially satisfactory returns are indicated as entirely possible and probable from most of the larger mine operations, and from the majority of the smaller ones as well, by the operation of a developed system of pooling by the smaller with the larger mines of their recovered and prepared sheet, for the enlarged accumulation in this manner of a properly graded joint stock, of sufficient extent, size, and range, to fill orders for the special sizes and shapes always required by the trade; this stock to be disposed of under a combined sales system.

In the same manner, and under a similar system, groups of mica operations, large and small, located in sufficiently close proximity (of which there are a number in the State) could in some instances combine their output of scrap, operating centrally located grinding plants for the utilization of this scrap, and possibly also to some extent of other by-products requiring crushing or some form of pulverization.

Auxiliary to such utilization of mine scrap, there are, (as will be hereinafter noted) a very considerable number of mica deposits located centrally with respect to the workable sheet mica mines, yielding mica suitable only for grinding, but affording definite amounts of this grade, so conditioned as to be recoverable at low cost.

The resultant ground mica from these deposits has been experimentally shown to be equal in grade to any other ground mica commercially marketed, under developed and proven methods of competent preparation.

There are indicated in this wholly undeveloped branch of the industry, some opportunities in the Alabama mica field for profitable investment.

In this connection, local conditions, as to hydro-electric leased power (already available at favorable rates over the existing transmission lines of the Alabama Power Company or by short branch lines) for the partial elimination of present mine waste by by-product utilization, and for the auxiliary handling of strictly grinding deposits, will become apparent from a study of present individual mine operations, solely based thus far as stated upon the realized small percentage recovery of strictly run-of-mine sheet.

With 120,000 H. P. already available, 120,000 H. P. under construction at Mitchell Dam, and an indicated as definite prospect in view in excess of 500,000 H. P. more by the completion of the projected power plant at Muscle Shoals, any Alabama industry of this nature will be able to estimate on hydro-electric leased power, in any desired amount, at a figure of cost equal to and in future probably less, than the present Niagara Falls basis.

The specimens and samples mentioned and referred to by "Exhibit Serial Numbers," representing all mine products of present or of possible commercial importance drawn from the localities and mines examined, have been collected for permanent display in the cabinets of the Alabama Geological Survey and placed there for public inspection and study in connection with this report.

TALLAPOOSA COUNTY.

The county, for the most part comprised within the Piedmont Plateau province, only a small portion of its southern area lying within the Coastal Plain region; presents therefore in surface conformation, characteristic variations, ranging from the flat uneroded Coastal Plain, to the hilly and much eroded and broken contours of its northern or Piedmont section, which section topographically, contains and is made up of hills and ridges having elevations of from 500 to 750 feet above sea level, and from one to two hundred feet above adjacent valley levels.

The Piedmont irregularities of contour generally speaking have their origin in denudation, the marked irregularities observable in the dip of the rocks showing crustal movements of wide extent. In the comparatively flat or rolling conformation of the southern part of the county, former irregularities of surface have been largely covered by Coastal Plain deposits, extending in some localities to considerable depth.

The Tallapoosa River, which flows through the county from northeast to southwest for a distance of some 75 miles, constitutes with its tributaries, the complete drainage system of the entire area.

This mature and favorable drainage system is a development factor of very great present and potential value to the county as a source of hydro-electric power, locally developed.

Dadeville, the county seat, is already supplied with light and power from a plant located on Sandy Creek. Alexander City, at present served by the transmission lines of the Alabama Power Company, could develop its own power if desirable near by on Big Hillabee Creek.

At Tallassee, in the southern end of the county, sufficient power has been developed on the Tallapoosa River and already utilized for the operation of a group of cotton mills, with available surplus.

Two miles north of Tallassee, also on the Tallapoosa, a forty-five foot head has been developed and a power plant erected, from which several thousand horse power is at present conveyed by a transmission line to Montgomery.*

In addition to these existing hydro-electric developments, there are other localities both on the Tallapoosa and on the smaller streams where added potential power in greater or less amounts may, and doubtless ultimately will, be produced and utilized locally in this county.

MICA DEVELOPMENTS.

Columbus Ware Mine, or "Mica Hill."—Recent active mica mining operations in the county have been largely

*This source of power is not available at present by reason of the failure of the dam some eighteen months ago. E. A. S.

confined to the six properties owned by the Coosa County Mining Company of Wetumpka, Ala., of which properties Mica Hill has been the major operation. It is located in the Southwest Quarter of the Southwest Quarter of Section 7, Township 22 North, Range 24 East, being about six miles northeast of Dadeville, near Easton, and about one quarter mile south of the main road known as the Montgomery Highway.

Topographically, the mine occupies the crest of a hill forming one of the highest points in the county, having an elevation of approximately 850 feet, tidal datum, and a rise of about 100 feet above adjoining valley level.

In conformation, the summit of the hill is cruciform, with the easterly arm eroded or lacking, the pegmatite bodies being similarly cross formed, and approximately occupying both axes of the hill. The country rock is a reddish mica gneiss, the pegmatite contact with which is somewhat irregular. Large masses of barren quartz outcrop on the summit along the northwest-southeast line or axis of the hill, dividing and separating the two distinct pegmatite bodies, which as developed, for a distance of some five to six hundred feet, have a general southwest dip varying on the slopes and shafts driven, from 35° to perpendicular. On and near the surface, the two pegmatite bodies appear to be some 50 feet apart, separated by a massive V-shaped quartz intrusion, approaching each other rapidly at the lower levels reached, their ultimate union at lower levels being indicated.

For purposes of identification and description, the easterly body of pegmatite has been known as the "punch vein." It was originally entered and worked by open cuts along its extension on the surface for some 500 feet. Subsequently, three slopes, located about 100 feet apart, have been driven down following the pegmatite seam for varying distances, the main and most northerly of these slopes being carried down to a connection with a vertical shaft, located in the westerly pegmatite body used as an air course. From this main slope, which was operated by means of a hoist, entries were run out at various levels north and south in the mica bearing pegmatite.

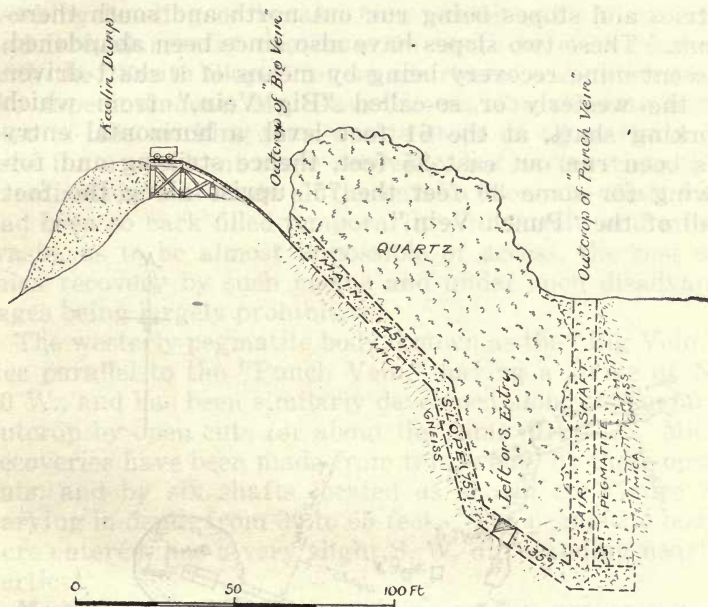


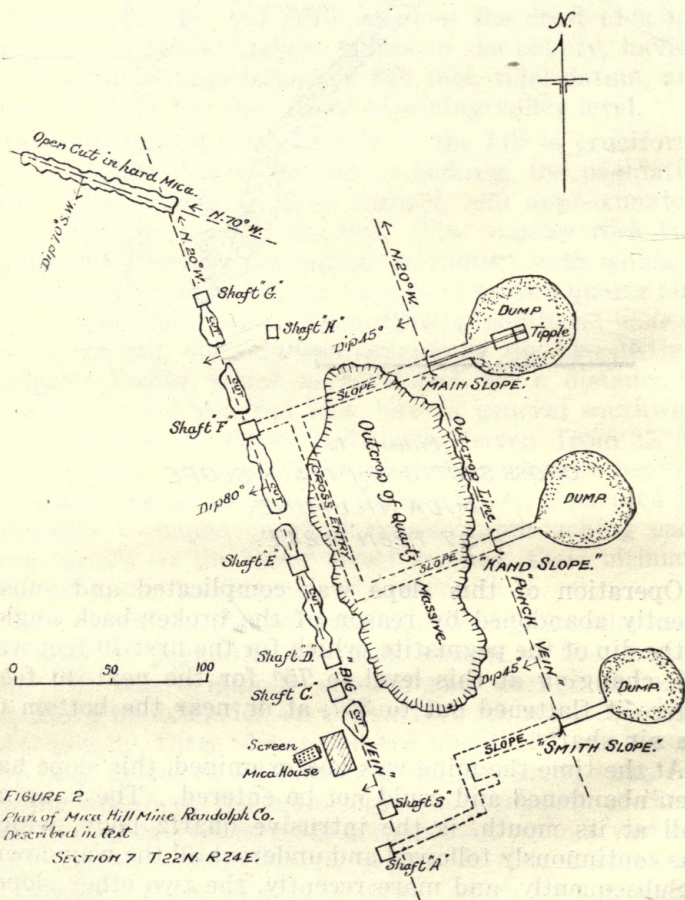
Figure 1.
CROSS SECTION of MAIN SLOPE
MICA HILL MINE
S 7 T 22 N. R 24 E.

Operation of this slope was complicated and subsequently abandoned by reason of the broken-back angles in the dip of the pegmatite, which for the first 70 feet was 45° , changing at this level to 75° for the next 40 feet, where it flattened out to 35° , at or near the bottom of the air shaft.

At the time the mine was last examined, this slope had been abandoned and could not be entered. The hanging wall at its mouth, is the intrusive quartz body, which was continuously followed and undercut all the way down.

Subsequently, and more recently, the two other slopes mentioned, known as the "Hand", and the "Smith" slopes, were similarly driven to a depth of approximately 80 feet,

entries and stopes being run out north and south therefrom. These two slopes have also since been abandoned, present mine recovery being by means of a shaft driven on the westerly or so-called "Big Vein," from which working shaft, at the 61 foot level, a horizontal entry has been run out east 35 feet, thence striking and following for some 30 feet the 75° uprise along the foot wall of the "Punch Vein."



At the head of the uprise, a north entry leads out horizontally along this foot wall about 40 feet, to the present

working heading or breast, from which point a narrow and irregular entry continues on north to a connection with the "Smith Slope" for an air course. As stated by the superintendent, Mr. Dave Norris, the ultimate purpose of this working plan was to stope on up to the surface for a resultant slope recovery, but at the time the examination was made all the entries from the shaft out had been so back filled temporarily with kaolin and mine waste, as to be almost impossible of access, the cost of mica recovery by such means and under such disadvantages being largely prohibitive.

The westerly pegmatite body, known as the "Big Vein," lies parallel to the "Punch Vein," having a strike of N. 20° W., and has been similarly developed along its surface outcrop by open cuts for about the same distance. Mica recoveries have been made from this "vein" by these open cuts, and by six shafts located as shown on Figure 2, varying in depth from 30 to 65 feet. The pegmatite body here entered, has a very slight S. W. dip standing nearly vertical.

Most of the original mica mining on this property was done on the "Big Vein," from which at various times and under previous ownership, mica in excess of 100 tons is stated to have been recovered and sold, running above general average in the percentage of sheet.

Practically all of the sheet mica obtained from this mine has been taken from the contact, next to the foot wall, and the continuance of this rule of occurrence was an observed and noted fact in all of the slopes and entries examined. No mica of large size has ever been found in the kaolin, which, however, carries in excess of 50 per cent. of small flake.

In the "Big Vein," the micaized portion of the pegmatite has an observed average thickness of from one to four feet, and in the "Punch Vein," of from 6 inches to 21½ feet; within which limits all of the mica of value as sheet is carried or comprised.

Outside of the micaized portions, the pegmatite bodies present the usual variations as to thickness, but are continuously persistent and never lenticular along the strike throughout the mine as thus far worked.

Owing to the elevation at which the deposits are placed and have been entered, water level has never been as yet reached in any of the shafts or workings. The feldspar of the pegmatites has been to the depth reached almost altogether kaolinized, the resultant clay carrying a heavy percentage of very fine flake mica. Considerably over 1,000 tons of this kaolin are already piled up in the various mine dumps which if washed and freed from mica

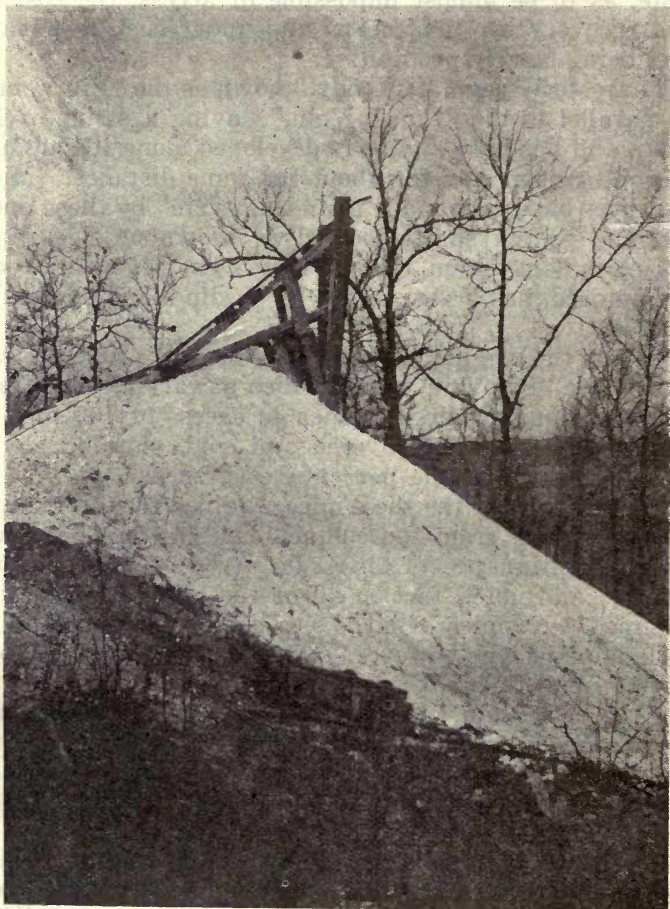


PLATE I.—MICA HILL MINE—KAOLIN DUMP.

and other impurities could probably be profitably sold. Samples of fresh run-of-mine kaolin were recently submitted to Trenton potteries, and were so favorably considered that a sample carload was subsequently ordered and is now being worked up at Trenton.

At the northerly end of its proven extension, the "Big Vein" is intersected by an unusual formation of hard mica forming an angle with it of 50° , or having a strike of $N.70^{\circ}W.$ This cross formation or intersecting mica body, has been opened up by a surface cut for a distance of 90 feet along its N. W. strike from the "Big Vein," and is traceable by outcrops for an additional distance in the same direction of some four or five hundred feet, under apparently similarly micaized conditions. As opened up and developed in the cut to a depth of five to ten feet, it has a width or thickness of about eight feet, and an observed dip S. W. of 70 to 75 degrees, both foot and hanging walls being red mica gneiss.

The mineralization varies from a hard form of A mica, to a mica schist made up of flake of all sizes, which as a rule, appears to be nearly all mica. Some 50 to 80 tons of this schist have been taken out of the cut and piled up along its sides. Very little quartz or any other form of inclusions appears to be present. A few of the lumps taken out carry a thin plating of botryoidal manganese.

As a source of ground mica, this deposit has distinct possibilities, if found after proper tests to be of acceptable quality, definite amounts of the above described grade being indicated as recoverable to some extent by economic open cut mining, and by subsequent underground methods, with a possible expectancy of alteration to other and better grades at lower levels.

A second occurrence of this same character is indicated by outcrops, striking approximately parallel to it, and located some 70 yards further south, following and underlying the crest of the westerly arm of the hill, and traceable for several hundred feet to the point where the ridge breaks down.

No attempt has been made to prospect this deposit, but if found to be of equal extent and similarly conditioned to the northerly cross formation, the two deposits, in

combination with the normal scrap output of the mine should justify a grinding plant of the minimum unit size taken in conjunction with the scrap recovered from other existing mines in the immediate district which would be available.

Since its acquirement by the present operating company, about 150 tons of mica in all have been recovered and sold from the Mica Hill mine. During the last period of operation, covering about ten weeks, working only a very small force, and recovering the mica by the crude and inefficient methods above described involving handling and rehandling in the mine, there was nevertheless taken out about 5,800 pounds of sheet, and approximately 60,000 pounds of scrap, 13,000 pounds of the scrap being partially cleaned by running it through a reel.

Of the approximately 9 per cent. of run-of-mine sheet mica recovered, about 3 to 4 per cent. of cut sheet appears to have been the net result in recent operations. The sheet mica taken out, is an amber muscovite of fair size, splitting well, and averaging about 3x3 inches in size. No larger mica has been as yet recovered in appreciable amounts.

It carries some inclusions and is uniformly more or less spotted, but has been sold as electric mica without rejection on this account being generally flat sheet, fairly free from other imperfections.

Exhibit samples, serial numbers 100 to 104 inclusive represent the mine products.

Carleton or Buttston Mine.—The Carleton mine belongs also to and has been operated by the Coosa County Mica Company. It is located in the S. E. Quarter of Section 22, Township 23 N., Range 24 E., being about 11 miles northeast of Dadeville, and about one-quarter mile south of Tallapoosa River, east of, and near, Germany Ferry.

The deposit of mica developed and mined is located in a low flat hill, lying between two branches of County Line Creek, having a summit elevation of 40 feet above creek level.

The mica recovered has been altogether of A form, hard and non-sheeting, suitable only for grinding. It is car-

ried in irregular lenses and seams of coarse pegmatite, which have no definite formation, being interbedded with crystalline quartz in large bodies and with both a white and yellowish feldspar, partially kaolinized near the surface, and but little altered or decomposed near the bottom of the cuts.

An irregular shaped area, about 200 feet wide from east to west, by 150 feet from north to south, running from the westerly arm of the creek to the summit of the hill, has been worked over by irregular pits and excavations, following up the various mica bodies found to be located along and occupying the fissures between the enclosing quartz and masses of mainly undecomposed feldspar, none of these workings having been carried to a depth of over 10 feet.

Within this area, and to a depth of from 5 to 10 feet, approximately 175 tons of A form mica, mainly in blocks of considerable size, is stated to have been recovered and sold as scrap during 1920.

Prices realized for it crude, with the attendant long truck haul to Dadeville, the shipping point, did not at the time justify deeper or more comprehensive methods of recovery, and the operation was in consequence for the time being abandoned.

Exhibit samples, serial Nos. 105-106, were drawn to represent the character of this deposit.

Berry Mine.—The Berry mine is located at Easton, in the N. W. $\frac{1}{4}$ of the S. E. $\frac{1}{4}$, of Section 12., Township 22 N., Range 23 E., being $\frac{1}{2}$ mile N. W. of Mica Hill, immediately south of the Montgomery Highway, and within a few yards of it.

The mine is also the property of the Coosa County Mica Company, but has not been recently operated.

Under previous ownership, and when at that time examined it had been opened up by means of several shafts driven to water level, from which a considerable amount of clear sheet mica of satisfactory grade was being taken out and sold.

The characteristics of the pegmatite body entered were a predominance of kaolin in which the mica was altogether carried.

Mine recovery was much complicated and finally abandoned by reason of the unsafe character of the schist hanging wall, containing mud slips near the surface.

When recently examined the shafts had caved in and the mine could not be entered.

Abernathy Mine.—The Abernathy mine is located in the E. $\frac{1}{2}$ of the N. E. $\frac{1}{4}$, of Section 7, Township 22 N., Range 24 E., near Easton.

The mine is a new prospect just opened up, and is located about 60 yards north of the Montgomery Highway, in a low flat hill.

Developments consisted of several small pits and a shaft about 10 feet in depth, from the bottom of which an entry had been run out into a bed of micaized kaolin, more or less intermixed with surface residual red clay.

The deposit had not been sufficiently prospected to form any definite idea either of its extent or character. About 2 tons of mica had been taken out, mainly in driving the entry, and was piled up on the bank, mainly consisting of small books, averaging in size about two by three inches, and of the grade to be expected under existing surface conditions, containing specks or inclusions, and somewhat folded and flawed. The mine is the property of the Coosa County Mica Company.

Exhibit sample, serial No. 107, represents the recovered product.

J. I. Easterwood Mine.—The Easterwood mine is located in Section 8, Township 22 N., Range 24 E., being $1\frac{3}{4}$ miles east of Easton.

Present mine workings are located near and on both sides of the Montgomery Highway. The deposit was originally entered by five old shafts located about 40 yards south of the road, from the bottom of which shafts stopes and entries were run out under a formation of white quartz boldly outcropping on the surface about centrally of the old workings. Very little information was obtainable as to the history of these old workings which could not be entered for examination, but a considerable amount of good flat mica, in medium sizes, is said to have been recovered from them by a Mr. Hamby and others. Preparations were being made to reopen them at

the time of the examination by sinking a new working shaft.

About 50 feet N. of the road, a new working shaft had been sunk 20 feet in depth, from the bottom of which an entry had been run out S. E. on a slope of about 10° in a body of grayish colored kaolin, much intermixed with small angular fragments of quartz and unaltered feldspar. From this stope, about 4,000 pounds of mica had been recently taken out by present operators, a portion of which stock was examined. The recovered mica is a muscovite of dark rum color, flat, free from specks or inclusions, running in sizes from punch to about 3x4 inches.

Exhibit sample, serial No. 108, represents the average mica last recovered.

Small surface prospect pits are observable at various points for several miles along and near the Montgomery Highway, following the N. E. strike of the pegmatite occurrences opened at Mica Hill, from which openings small quantities of mica have been at various times recovered by farmers owning the properties, and generally disposed of to the Coosa County Mica Co.

Saunders Pit.—In Section 3, Township 22 N., Range 24 E, 11½ miles S. of Buttston, on the Saunders property, a small prospect pit has been opened up some 200 yards W. of the road, in which a greenish muscovite mica was discovered, a small amount of which had been taken out.

Exhibit sample, serial No. 109, is from this pit.

Thomas Mine.—Southwest from Mica Hill, although the continuance of the micaized pegmatites is occasionally indicated by surface outcrops, there has been very little exploiting done and no mines or prospects were ascertained to have been opened up, except one located on the C. W. Thomas property, about 6 miles S. W. from Dadeville. The Thomas mine was not examined, but is stated to have been worked intermittently during 1920 and the output sold to the Coosa County Mining Co. Examination of the stock so disposed of and on hand shows it to be a muscovite of very light rum color, practically colorless in the thin sheet, containing no inclusions, and running in sizes up to 4x6 inches.

Exhibit sample, serial No. 110, is from this stock and representative of the Thomas mine.

RANDOLPH COUNTY.

Physiographically, Randolph County lies in one of the most southerly sections of the Piedmont Plateau.

Geologically, it is an eroded plateau of extensive and strongly marked weathering and erosion, the underlying rocks being of igneous and metamorphic origin.

The mica bearing section of the county is mainly, if not altogether, comprised within its western half, being areally carried in a belt or zone of northeast to southwest extension across it from the Georgia state line to Clay County.

The prevailing rocks of the micaized zone are mica and hornblende schists, gneiss, and granite with their intergradations. The general N.E.-S.W. strike of the measures, carries, and is subject to, frequent marked and wide local variations, due to extensive folding and contortions.

Intrusions and interstratifications of quartz veins are of general occurrence as also less frequently of hornblende, and occasionally of chlorite, schists.

Topographically, the mica deposits developed are located mainly in the hilly to mountainous section of the northerly watershed or divide, at an elevation, tidal datum, of 800 to 1200 feet, and approximately 100 to 200 feet above neighboring valley or stream level. So located, the mica bearing pegmatites largely outcrop, resultant kaolin deposits carry light over-burden of residual soil, and mining operations are frequently facilitated by favorable mine drainage, and by the more than ordinarily lower level of surface water.

As previously stated, the first attempted recovery of mica commercially in Alabama, was made in Randolph county near Micaville, in what was subsequently known as the old Pinetucky gold mine, probably about the year 1870.

Mica occurrences in that locality being more clearly marked on the surface and of wider extent than at any

other point in Alabama, more resultant development and actual mica mining has been in consequence intermittently carried on there than at any other point in the State, the vicinity of Pinetucky, and of Micaville, being at the present time still the center of greatest activity. Some six or eight new companies have been recently incorporated, owning and operating mines in the Micaville-Pinetucky group.

A potential factor in this local mica development, of possible and material future importance, although not as yet taken into consideration as any definite feature of present mine operations, is the clearly proven existence there, of large deposits of china clay, suitable for porcelain manufacture, which are carried in the mica bearing pegmatite and are as yet only a waste product. Attention was called to this fine porcelain clay by Tuomey* as far back as 1855, and convincing tests were made of them later by the Alabama Kaolin Company, at Trenton, New Jersey potteries, in 1889.

Arnott Mica Mine.—The Arnott Mica Mine, belonging to and at present operated by the Minot Mica Company, of Minot, South Dakota, is located in the S. W. $\frac{1}{4}$, of the N. E. $\frac{1}{4}$, of Section 2, Township 18 S., Range 10 E., about $1\frac{1}{2}$ miles W. of Micaville, and $\frac{1}{4}$ mile S. of the Cleburne County line.

The body of pegmatite developed in this mine has a clearly defined strike of N. 20° E., and a regular dip of 45° S. E. It is traceable by surface outcrops for a distance of 300 feet or more N. E., and nearly the same distance S. W., from the main shaft.

The mine is located in a low flat hill or ridge, having a summit elevation of about 50 feet above the run of the branch or small creek east of the hill. In respect to development, this mine is one of the few mica deposits in the State which have been competently opened up in accordance with ordinary and customary mining methods, based upon an expectancy of and due consideration for, reasonably permanent and economical mine recovery.

Original development was initially made by the present shaft, 15 feet in depth, located on the outcrop, from

*Second Biennial Report of the Geology of Alabama by M. Tuomey. 1855.

the bottom of which shaft a slope was driven, following and lying in the pegmatite, which proving to be continuously micaized and extensive, justified the subsequent and proper method of entry by the present tunnel, run in from the base of the hill. An open entry cut 80 feet in length reaches the portal of the tunnel, which in a further length of 80 feet intersects the pegmatite body at the foot of the slope, affording proper ventilation and facilities for economic mica recovery.

Right and left entries from the slope have been driven on three levels, connected at intervals by stopes, leaving proper intermediate roof support, and effectively blocking out the ore as is shown in Figure 3, a plan of the mine workings.

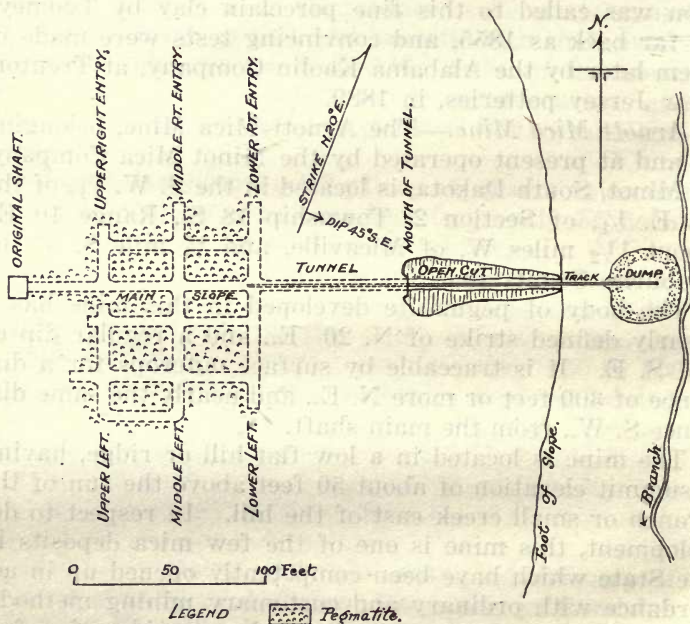


FIGURE 3. Plan of the mine workings of the Arnett Mica Mine Randolph County, described in text.

SECTION 2 T18S R.10E.

At the tunnel level, the lower right entry extends 40 feet N., and the lower left entry, 60 feet S. Ten feet higher vertically, the middle right entry has been driven 40 feet N., and the corresponding left entry 60 feet S., connection between the first and second working levels being by means of the three stopes shown on the plan. The third or upper working level, located 10 feet higher than the second or middle level, and about 6 feet below the bottom of the vertical shaft, is opened up by means of a 30 foot right or N. entry. The south workings on this level are reached by three stopes from the second or middle level, and have not been as yet run out N. to a connection with the main E.-W. slope. On this left or S. entry two working stopes, or rooms, have been driven above it ten feet in length.

The pegmatite deposit having been found to be narrowing in the N. entries to finally about 3 feet or less, and correspondingly widening in the S. entries to a final width of 10 to 12 feet or more, the N. entries were temporarily abandoned, and most recent recoveries made altogether from the south side of the mine. All indications observable, both on the surface and in the mine, point to a definite continuance of the pegmatite body S. beyond the present mine limits, with favorable micaization. From surface outcrops it is indicated also that its extension N. may be possibly lenticular, and quite likely to widen out in that direction beyond present mine limits, or to prove of side displacement possibly overlapping. The narrowing or pinching observed in the N. entries is apparently caused by a rise in the foot wall.

The prevailing characteristics of the pegmatite body entered are a coarse aggregate, containing quartz intrusions in mass formation, walled uniformly top and bottom by a reddish mica gneiss. An unusual condition observed as compared with other mines in this immediate locality, is the occurrence of the mica generally, and more especially the larger crystals recovered, imbedded in and on the mica gneiss, along both the upper and the lower contact, and in but few instances in or on the quartz. This has been, according to the superintendent, Mr. John Arnett, the quite uniform method of occurrence. The peg-



PLATE II.—ARNOTT MICA MINE—VIEW LOOKING W. SHOWING
TUNNEL ENTRY.

matite body as far as developed, lies in definite conformity with the enclosing mica gneiss, and with the prevailing dip and strike of the country rocks.

Practically no mica was mined during 1920, owing mainly to unsatisfactory marketing of the product recovered during the previous year, amounting to between 40

and 50 tons. This fact appears to have been largely due to inexperienced preparation of the sheet mica stock offered for sale, and to a considerable extent disposed of on the run-of-mine basis, the grade of the mica recovered, judging by examination of some 2,600 pounds of mine run sheet now in the house, being much above average, and grading to fair and occasionally large sizes of clear, flat, amber muscovite, without specks or inclusions, to some extent more than ordinarily free from imperfections and therefore probably suitable for ordinary electrical if not for high potential uses.

About 16 tons of mica of all grades was stated by Mr. Arnott to have been recovered and sold in 1919, and the partially and imperfectly graded stock residue of about 18 tons, is now on hand in the mica house awaiting disposition.

A number of large crystals of mica, weighing 50 to 100 pounds or more each, have been recovered. These crystals, as is usually the case, were "tangle sheet" or imperfectly splitting on the edges, but produced some good sheet in the body of the block.

Some idea can be formed of recoverable mica percentages in the pegmatite, and of relative mine cost, from the stated fact that during the last period of operation, a small working force of three men for two weeks, and four men for the same additional period recovered approximately 18 tons of mine-run block of all classes.

Exhibit sample, serial Nos. 111-112 were taken from the Arnott mine and are representative.

Great Southern Mica Mine.—The Great Southern mica mine is located in the S. E. $\frac{1}{4}$ of the S. W. $\frac{1}{4}$ of Section 6, Township 18 S., Range 10 E., about 1 mile S. of Mica-ville.

It is one of the oldest and has been one of the most extensive mica developments in the State, and was last worked by the Great Southern Mica Company, who ceased operations as nearly as could be ascertained about the year 1907. The material facts in connection with the mine itself are involved in obscurity, as the mine labor employed was largely imported, very few local men ever having worked in it, and the owning and operating com-

pany from some cause allowing no one to enter it except their own employees. It was impossible to find any one now living near there who had seen the inside of the mine.

That it must have been an extensive deposit favorably conditioned, is indicated by the complete and efficient equipment of the mine, the length of its period of oper-

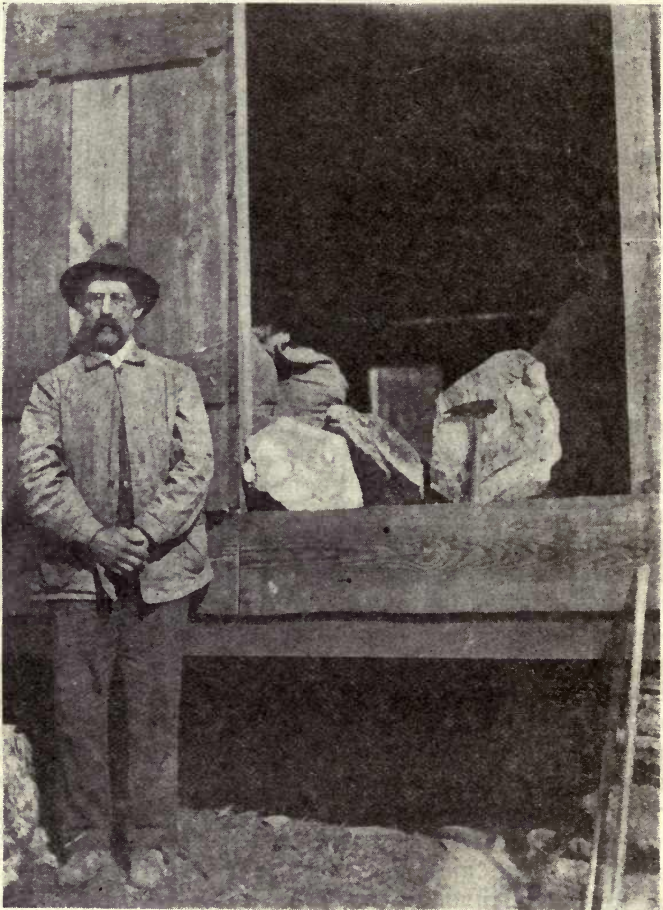


PLATE III.—ARNOTT MICA MINE—SPECIMEN MICA BLOCKS.

ation, and the large and regular amounts of mica observed to have been hauled from it by wagons 18 miles to Heflin, where the sheet mica was trimmed and graded in the company's shop.

Mine operation was carried on by means of a slope driven on the dip of the pegmatite body entered, equipped with hoisting engines, etc. The old compressor still in place shows that power drills were used in the workings, the equipment including pumps and all other auxiliary power plant and underground mine facilities—indicating an apparently satisfactory and economic operation.

High grade, flat sheet, amber muscovite, running in more than average large sizes up to 12x14 inches, is stated to have been the output of the mine.

The appearance, size, and character of the weathered mica observable in the numerous old waste heaps lying about the slope and in the sides of the seven or eight old surface cuts and shafts, would seem in some measure to confirm this statement.

Two, and possibly three, distinct pegmatite formations are traceable on the property of indicated N. E.-S. W. extension, but approaching a strike of due east and west, the mine proper being located on the most easterly of these deposits. All the old shafts and the slope having fallen in, no examination of the mine could be made. It is stated that the mine will be shortly reopened, and operation of it resumed, either by the Great Southern Mica Company or its successors.

Edwards Mica Mine.—The Edwards mica mine is located in the S. W. $\frac{1}{4}$ of the S. E. $\frac{1}{4}$ of Section 6, Township 18 S., Range 10 E., being on property immediately adjoining the Great Southern on the east.

It has been worked at various times in a small and intermittent way by different people, and is at present owned and in process of development by the Consolidated Mica Company of South Bend, Indiana.

Recent exploitation by the Consolidated has been by means of four shafts, and several open cuts, all located in the S. W. corner of the lot above described. Under the former and last preceding ownership of Mr. H. E.

McCormack of Birmingham, Ala., the old pits just E. of the Great Southern property line were reopened, and several tons of clear amber muscovite sheet of medium to large size were recovered from an extensive bed entered of a pure white kaolin of porcelain grade.

This plan of development has been abandoned by the present operating company in favor of recovery by means of five shafts, spaced at intervals of about 300 feet, along a line running due E. from the old surface cuts, following, and being driven down in a pegmatite lead having a local strike of 70° , N.W.-S.E., and a dip, difficult to determine, but approaching the perpendicular.

No accurate idea can be formed of the thickness or of the extent of the micaized pegmatite body entered by these shafts, as no cross entries have been as yet driven.

The observed characteristics of the pegmatite to the depth reached, are a predominating partially kaolinized feldspar, accompanied by small chips and angular fragments of quartz, except in the most westerly of the shafts, in which a considerable body of massive white quartz was encountered and driven through. The foot and hanging walls of the pegmatite not having been reached, their character has not been determined but is probably the red mica gneiss generally observed in other occurrences near by.

The two most easterly shafts have been driven to a depth of 26 feet, partially timbered at the bottom, and contained some water. The third shaft, driven centrally of the group, to a depth of 25 feet, has a N. entry at the bottom, 15 feet in length, which was said not to have yet reached the N. wall of the pegmatite. Some 20 tons of white quartz was removed from this shaft in sinking. along the contact with which quartz several tons of mica were recovered. The shaft lies altogether in hard material and is not timbered. West of this shaft about 25 feet. another shaft 18 feet deep has been sunk, and a third shaft, some 25 feet still further W., to a depth of 25 feet; the latter shaft, solidly timbered from top to bottom and containing some water, being bottomed in the kaolin bed opened up by the adjoining surface pits previously mentioned.

Very little of the mica recovered from these operations came from the two easterly shafts, most of it having been taken as stated from the central shaft. The total output, the amount of which could not be ascertained, was said to be represented by about 12 tons of crude mine-run mica stored in Mr. Pat Ayers' barn, which was examined and is represented by exhibit sample serial No. 113.

Liberty Mica Mine.—The Liberty mica mine is located in the S. W. $\frac{1}{4}$ of the N. E. $\frac{1}{4}$ of Section 1, Township 18 S., Range 10 E., being about $\frac{1}{2}$ mile S. W. of Mica-ville, and $\frac{1}{4}$ mile S. of the Cleburne county line.

It is understood to be owned and operated by the Liberty Mica Company. Considerable development work was done on this property during 1919-1920, but work was practically discontinued during the last half of 1920.

The original opening up of the mine prior to present ownership was by an open cut along the outcrop about 100 feet in length, in which cut the mica was crudely won by stoping down on the pegmatite some 20 or 30 feet at points most obviously micaized. Recoveries in these earlier operations were largely if not altogether of A-formed mica, of therefore inferior non-sheet grade, which is characteristic of the deposit near the surface. Observing the change to more perfect forms of crystallization in the mica blocks at lower levels, present operators later on opened the mine by means of shafts and by a subsequent and final slope operation as shown in Figure 4.

In all, five shafts have been sunk, in the relative positions shown on the general plan of the mine, to intersect the pegmatite at various levels.

The pegmatite body entered, has on the outcrop an apparent strike of about 50° N.E.-S.W. and a dip S.E. of 40° - 45° .

The main working shaft D., is 35 ft. in depth, with a horizontal entry running N. at the bottom for a distance of about 40 feet. From this entry the S. stope or working heading, 60 feet in length E., and the N. heading, 35 feet in length E., were driven down on the dip of the ore body. From these workings, the larger part of the mica recovered in the mine has been taken out. Subse-

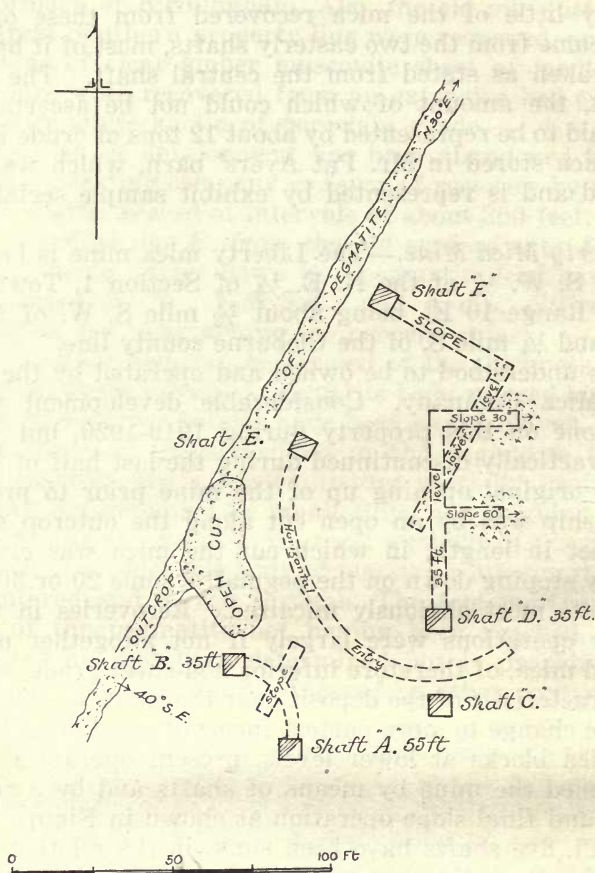


Figure 4.
PLAN of THE LIBERTY MICA MINE.
S. I. TIBBS. R. IOE.

quently, a slope was started at F. near the outcrop, and driven down under the above described workings, approximately as shown on the plan, which was the point of active development at the time of the cessation of last operations.

Shafts A., B., and E., were largely experimental prospecting. Shaft A., known as the "Zeissmann" shaft,

is 55 feet deep and was originally connected with shaft B., which has a depth of 35 feet, by a circuitous entry. Very little practical information or benefit appears to have been gained from these two shafts, although some good mica was recovered from there. Shaft E., located near the outcrop, was further exploited by another circuitous entry intended to reach shaft D., with which it is understood it was finally connected. All these operations appear to have been largely preliminary to the final and practical development of the mine as above described by means of shaft D., and the slope.

The pegmatite body developed is a coarse aggregate of fairly uniform width, having a maximum thickness in the mine workings of 18 feet, and containing few if any inclusions, partings, or horses. It appears to lie in general conformity with the enclosing rocks which are red mica gneiss.

As above stated, the mica recovered in all workings near the surface, was mainly of A-form, but in the final and lowest working levels and entries, flat mica, of steadily improving grade, replaced almost altogether the surface mica of defective crystallization. It was found to be located along the contacts, and mainly with the foot-wall, and in kaolin.

Some estimate may be formed of the ruling mica percentages in the "vein", and the cost of recovery, from the stated fact that in final slope operation, from 2,200 to 2,600 pounds per day was the average with a working force of 5 men.

The best expectancy of this mine, both as to grade and amount is indicated as carried below water level and has not as yet therefore been determined.

As stated by the superintendent Mr. Tapley, the gross amount of mica recovered by the present operating company has been approximately 40 tons. About 32,000 pounds of run-of-mine block was weighed up, out of which 3,100 pounds of smooth flat amber muscovite was sheeted and sold. As in all these mines and prospects, practically no scrap has been made use of or as yet sold.

Exhibit sample, serial Nos. 114-115 are from the Liberty mine.

Pinetucky Mica Mine.—The old Pinetucky mine, which is historically believed to have been the first mica mine worked commercially in Alabama, is located in the N. W. $\frac{1}{4}$ of the S. W. $\frac{1}{4}$ of Section 12, Township 18 S., Range 10 E., and now belongs to the extensive holdings in this county of Mr. Sam Wallace, one of the pioneers of the Micaville district and its principal factor of present and past development.

According to Brewer*, who examined it thoroughly in 1890, going all through the then extensive underground workings, the deposits of pegmatite entered, made up of several distinct parallel leads or "veins" all having a N. E.-S.W. strike and a S. E. dip, are well marked, extensive and unusually micaized.

Mica crystals, yielding good flat clear-sheet muscovite running to 10x12 inches in size and in considerable amounts to 6x7 inches, are reported by Brewer to have been at that time taken out, sheeted and sold to the stove trade from this mine.

None of the old workings may now be entered, but their extent is evidenced by a central shaft over 60 feet deep, two tunnels, and by some 30 or 40 old cuts and prospect pits, being the developments made by the Alabama Gold Belt Mining Company during a period of operation extending from 1890 to 1893.

The discovery at that time of rich veins of gold on the property in these mica mine workings, caused it to be abandoned as a mica mine in favor of a recovery of the gold values carried, which later on resulted in extensive gold mining, and in the erection of the present reduction plant belonging to Mr. Sam Wallace, located on the adjoining lot.

No attempt has since been made to resume mica mining on the property which the indicated facts would seem to amply justify, as the old workings, in part at least, might possibly be reopened without much difficulty.

The rotted and weathered mica observable on some of the old dumps, is of a size and quality to bear out apparently Brewer's statement relative to the grade of mica

*Report of Wm. M. Brewer, Asst. Geologist, Bulletin No. 5, Ala. Geological Survey, 1897.

constituting the reported output of the old mine, of which there can be no doubt.

Schefner Mine.—The Schefner mine, originally opened by Mr. Frank Schefner, in 1919-20, is located in the N. E. $\frac{1}{4}$ of the N. W. $\frac{1}{4}$ of Section 1, Township 18 S., Range 10 E., being $\frac{1}{2}$ mile west of Micaville, adjoining, and lying immediately S. of, the Cleburne-Randolph county line. It has recently been acquired and is now being further exploited and opened up by the Midland Mica Syndicate of Minneapolis, Minn.

Recent developments on this property have mainly centralized about an old open cut located on the Eastern Central area, together with an old working mine shaft at present 64 feet deep, from which flat mica of good sheeting quality, running to large sizes, is known to have been recovered by Mr. Smith of Wetumpka, Ala., including some larger crystals, one weighing 300 pounds. Examination of old weathered mica in the dumps appears to be confirmatory of these statements.

Examination of the old shaft, which had not caved in to any extent although not timbered, showed a circular chambered out stope at the bottom all around the shaft base, carried out as far into a kaolinized pegmatite deposit as was safely possible without timber sets and proper lagging for roof support. No entries had been driven either with the strike of the chute or across it, so that the walling and the form of the pegmatite body has not been defined. The pegmatite aggregate is largely made up of quartz, in and around which the mica is carried, but appears to have been robbed out before abandonment of the operation, such mica as remained being principally small, but of flat sheet.

Several new shafts and a number of new and old prospect pits, have been opened up near the old mine shaft above described, located on outcrops, mainly in and around the edges of a well-defined and extensive outcrop of quartz.

As defined by these developments, the pegmatite leads here opened up, of which there appears to be several, have a general N. E.-S. W. strike, dipping S. E. at various, but generally steep angles.

With one exception, none of these prospect pits has been carried deep enough to develop anything but surface mica, which was recovered to greater or less extent in nearly all of them, some of it of A-form, other and deeper pits carrying flat mica of better grade.

In the one shaft carried to a depth of 32 feet, mica shows on all four sides and all the way down, some of the crystals being of large size. On the W. side of this shaft, a quartz horse was driven through for a distance of 20 feet.

Near the S. W. corner of the property, just E. of the W. property line, and within a few yards of the "Old Indian Pits," located on the adjoining property, an old surface cut had been cribbed and converted on the E. end into a shaft, which was then lowered some 15 ft. and subsequently abandoned as unsafe without proper timber sets. The mica recovered from this shaft was largely small but of fair quality. Exhibit sample serial No. 116 is from the Schefner Mine.

Indian Mica Mine.—Location, the N. W. $\frac{1}{4}$ of the N. W. $\frac{1}{4}$ of Section 1, Township 18 S., Range 10 E.

The property has recently been purchased by the Alabama Mica and Manufacturing Company of Baltimore, Md., and its immediate development by this owning company is announced, together with other properties in the immediate vicinity also formerly owned or recently acquired.

There has been no recent prospecting done. The old mine workings, some of which are by tradition ascribed to the Cherokee Indians, consist of two circular 50 foot shafts connected by tunnels with a large and deep cut bearing evidence of extreme age.

Judging by old books dug out of the dumps, the mica recovered in the cut and in the shafts and tunnels, was not of A-form but flat sheet of good quality and fair sizes, which is said by old residents to have been its character. The output, seemingly, should have been considerable and the grade satisfactory to justify the extensive developments made under the crude methods employed.

Crystal Clear Mine.—The location of this mine is in the S. E. $\frac{1}{4}$ of the N. W. $\frac{1}{4}$ of Section 1, Township 18 S.,

Range 10 E., lying immediately W. of the Liberty mine. It is owned and operated by the Consolidated Mica Co., of South Bend, Indiana.

The pegmatite dyke entered has a definite indicated strike across the property of about 45° N.E.-S.W., dipping $40-50^{\circ}$ S.E. As far as developed, it lies in quite regular conformity with the enclosing red mica gneiss, and carries a fairly uniform width of about 10 to 12 feet.

The pegmatite is made up of an aggregate of small fragmentary quartz and feldspar, the latter being largely kaolinized. The mica recovered had been, prior to the examination, altogether in small sizes but of flat clear sheet of good quality.

The first shaft sunk, set off too far E., did not reach the dyke at a depth of 20 feet, and was abandoned. It is uniformly gneiss walled from top to bottom. Subsequently, two more shafts were sunk nearer to the outcrop, one 15, and the other 30 feet in depth, connected on the 15 foot level by a crooked horizontal entry following and lying in the pegmatite, the mica mined, recovered from these workings, being hauled to the surface from the main shaft by windlass and bucket.

The operation thus far has been crude and in the nature of a prospect, and has not been properly placed or of sufficient extent or depth as yet to constitute any proper proof of the mica reserves present or of their character. Near the S. W. corner of the property, and possibly on the S. W. extension of the dyke opened at the mine, an outcrop of pegmatite shows up very plainly, which near the surface is heavily micaized. It has been driven into on the adjoining property a few feet only S. of the property line, and large blocks of A-form mica exposed in the contact next the hanging wall, bedded in and on massive quartz. Exploitation of the pegmatite at this point on the property owned, would be promising, and could be easily and effectively done.

Week's Mine.—Location, the N. E. $\frac{1}{4}$ of the N. W. $\frac{1}{4}$ of Section 7, Township 18 S., Range 11 E., near and S. E. from and cornering with the Great Southern mine. The mine is owned and is being opened up by the American Mica Mining Co., of Minneapolis, Minn.

Development work so far has been directed toward ascertaining the form, character, and precise location of the pegmatite dykes, of which there are several carried in the hill where the mine proper will be opened up.

Topographically, this hill or section of a ridge is of N. to S. extension, rising some 70 to 90 feet above neighboring branch or creek level.

It is crossed near its northerly end by two and probably three pegmatite dykes, striking about $N.70^{\circ}W.$, and dipping S., at angles not yet fully determined.

Country rock measures on the contrary, near and on the surface, appear to carry the average ruling N.E.-S.W. strike of the district, indicating a cross formation; which condition appears to be closely paralleled also on the Edwards property immediately N. of it, and previously described, as also may be the case if the facts were ascertainable in the Great Southern mine.

Considerable old mining has been done on the property both for mica and for kaolin, presumably by or for the Alabama Kaolin Company about the year 1888, evidenced by an old shaft originally 40 ft. deep but milled in about 10 feet, also by a surface cut some eight to 10 feet deep, said to have been opened up principally for kaolin, samples of which clay were among those tested favorably for porcelain manufacture by Trenton potteries. Some of the largest and best mica ever recovered in the Micaville district are stated by Mr. Pat Ayres to have been taken out of this old shaft, which is now being timbered up preparatory to re-entry of the old underground mine workings. Preparatory to this development, the old cut next to the outcrop was cleaned out and lengthened along its N. E. strike, an included quartz horse being taken out with recovery of some 1,600 pounds of flat mica in small sizes next the upper contact and around the quartz horse. The old working shaft now being re-opened lying at the proper distance south of this outcrop tested, is correctly placed to reach this pegmatite body and develop it at proper levels. Water level is indicated at approximately 70 feet.

On the central pegmatite dyke, at a point about 200 feet N. of the old working mine shaft, a surface outcrop

was first opened up by a shaft, from which a favorable recovery of large crystals of weathered and clay stained surface mica was made.

From the bottom of this shaft, at a depth of 10 feet, a slope has been driven down following the dip of the pegmatite immediately under the hanging wall, at a slope angle of 30-35°, due S. in direction, for a length of 62 feet. At the slope head, a quartz horse was blocked out, and left standing for roof support.

The pegmatite body followed is very irregularly lenticular, with frequent intrusions of the peculiar red mica gneiss walling, represented by exhibit sample, serial No. 117. The foot wall is apparently at no point reached along the floor of the slope, kaolin showing in this floor. The thickness of the dyke is therefore not determined, but as far as proven is in excess of eight feet. The apparent narrowing or pinching out at the bottom of the slope may be intrusive, or a roll in the foot wall.

The special characteristics of the pegmatite, are a coarse aggregate, the feldspar largely kaolinized, and a dissemination of kaolin in small streaks through the mica gneiss intrusions as shown by exhibit sample, serial No. 118.

About 5 tons of mica, a large proportion of which was flat sheet of fair sizes, some of it of very high grade, was recovered in sinking this shaft and slope, most of it being taken from the hanging wall contact, where a number of fine crystals were still in place at the time of the examination.

Exhibit sample, serial No. 119, was taken from the roof contact midway of the slope, and represents the grade of mica recovery. It is an amber muscovite, in flat sheet, carrying few imperfections and is free splitting, of very satisfactory grade, indicating an expectancy of high grade mica from this mine when carried down to the lower levels, and fully developed.

Occurrences of kaolin are in small streaks and beds intermixed with granular quartz distributed uniformly through the pegmatites.

The micaized continuity of the dyke N.W.-S.E. has not as yet been determined either on the surface or by entry cuts from the slope.

The exploitation of this property, which contemplates also boring tests, is being carried on in a thorough and competent manner by experienced mining men, and by first establishing all the main essential facts relative to the form, character and precise location of the deposits to be entered for a permanent and economic mine recovery has already very encouraging and satisfactory prospects.

Consolidated Mica Mines.—During 1918, a selected group of mica properties aggregating about 600 acres was acquired by the Consolidated Mica Company of South Bend, Indiana. Extended prospecting has since been done on these properties, several producing mines having been opened up, the output of which was shipped to the manufacturing plant operated by the Consolidated Company at South Bend.

Mention has been previously made of two of these properties from which this output of mica was mainly drawn, viz; the Edwards, and the Crystal Clear mines.

No mica having been sold by this company, the total amount recovered being as stated required for its individual plant consumption, the precise amounts of mica taken out from this group of properties were not ascertainable and can not be stated or approximated.

The general and preliminary exploitation which was desired and undertaken of so large a combined property, necessarily limited the amounts of actual mining done, (which awaited the determination of the most favorable points for mine entry) and tended to restrict the prospecting largely to shallow tests, affording no reliable idea of possible expectancy as to the amount, and more especially in the matter of the grades of mica recoverable at proper levels.

Active mining was discontinued during the early part of 1920, and has not yet been resumed by this company.

Acknowledgment is due the superintendent of the Consolidated Co., Mr. J. M. Seabrooke for information fur-

nished and for assistance given in going over the work done under his direction at the following localities:

The S. W. $\frac{1}{4}$ of N. W. $\frac{1}{4}$, of Section 8, Township 18 S., Range 11 E.—One, and probably two, distinct and parallel leads of pegmatite are indicated by outcrops as crossing this lot with an observed strike of N. 45° E., dipping S. E. Developments made were on the most westerly of the two leads, near the center of the 40, and consisted of shafts about 20 feet in depth, one of which being wrongly located developed nothing, the other yielded only small mica from a kaolinized dyke made up of an aggregate of small angular fragments of quartz in formative kaolin.

S. W. of this shaft, in a bluff on the creek bank, the same pegmatite body is exposed under a massive overlay of quartz, carrying some sizable mica crystals next to the upper contact. The developments made on this lot have not been properly located to have any material bearing on the possible mica values carried.

The N. W. $\frac{1}{4}$ of N. E. $\frac{1}{4}$ of Section 6, Township 18 S., Range 10 E.—Two leads of pegmatite of N.E.-S.W. extension are traceable across this property. On the most westerly of these leads, a shaft was being sunk at the time of the examination in which shaft good flat mica of fair size and in considerable amounts was being taken out near the bottom, mainly recovered from the upper or hanging wall contact of a kaolinized pegmatite dyke eight feet in thickness, the foot wall having been not yet reached.

On the easterly lead, pegmatite shows up just south of the house in an outcrop of quartz, but no testing had been done here or elsewhere on this lead.

The S. E. $\frac{1}{4}$ of N. W. $\frac{1}{4}$ of Section 6, Township 18 S., Range 10 E.—Two and possibly three pegmatite formations are traceable across this property of N.E.-S.W. strike. Developments have been limited to the sinking of two pits in the S. W. corner of the lot, from which, to the depth reached of about 15 to 20 feet, only A-form mica in small amounts had been taken out.

S. W. $\frac{1}{4}$ of N. W. $\frac{1}{4}$ of Section 6, Township 18 S., Range 10 E.—Known as the

"Bagley Tract."—Exploitation in a limited way as yet has been by means of five pits, located, two in the S. E., one in the S. W., and two in the N. W. corners of the 40. In the N. W. corner, E. of the road, a shallow 8-foot pit developed a recovered small amount of A-form mica. A second pit, opened up 200 feet W. of the first one, showed about the same conditions, as did also the pits sunk in the S. E., and in the S. W. corners of the lot close to the W. property line. Just across this line, on what is known as the

"Alexandria Lot," there is a closely combined group of some five or six old open cuts in which a fairly good showing of A-form and of some good flat mica was observable. As the pegmatite opened up by these old workings has an indicated N. E. extension apparently into and across the *"Bagley Lot,"* it may, by competent prospecting, be traced up and found to be there similarly micaized. The openings on the N. W. corner of the lot are said to have been made under the direction of Prof. Bain of the University of Minnesota, and appear to have been suggested by an observed and heavy outcrop of quartz, but lie altogether in soft mica schist and were not of sufficient extent or carried to sufficient depth to afford much information of importance as to pegmatite conditions existing under or associated with the quartz.

The N. W. $\frac{1}{4}$ of N. W. $\frac{1}{4}$ of Section 6, Township 18 S., Range 10 E.—Known as the

"McAdoo Lot."—No recent work has been done on this 40, which was at one time developed, and mica recovered, from an old shaft and tunnel located in the S. E. corner of the property. These old workings are now inaccessible, and nothing definite is ascertainable about their history or as to the mica recovered from them.

The S. E. $\frac{1}{4}$ of N. E. $\frac{1}{4}$ of Section 2, Township 18 S., Range 10 E.—Property immediately adjoins the *"Arnott"* Mine. On the east, near its N. E. corner, a pit 8 feet deep, opened up on a pegmatite outcrop striking N. 40° E., and dipping 30° S. E., developed some good flat mica of small to medium sizes carried in a dyke about 3 feet in width. Near the N. W. corner of the lot, two pits have been sunk to a depth of 20 feet, developing nothing because im-

properly located. Proximity to old workings from which good mica is understood to have been taken out, especially in the old tunnel which has since caved in, led to these attempted new developments.

The E. $\frac{1}{2}$ of S. W. $\frac{1}{4}$ of Section 4, Township 18 S., Range 10 E.—Practically in the centre of these two 40's, an open cut about 10 feet deep exposed a pegmatite dyke dipping S. E. under a quartz hanging wall, carrying interbedded on and below it masses of A-form mica of large size. Five feet of pegmatite below the quartz has been cross cut, with the foot wall not yet reached. The form of crystallization improves at the bottom of the stope driven under the quartz, the A-form showing a marked tendency toward alteration into sheet mica, some good books being found in the upper contact.

One-half mile due west of this pit, and about the center of the W. $\frac{1}{2}$ of the S. W. $\frac{1}{4}$ of the same section, a similar but larger old entry cut about 100 feet in length develops closely parallel conditions, the pegmatite entered carrying heavy quartz exposures on the hanging wall, below which masses of A-form mica of very large sizes are imbedded. Several smaller pits adjoining the cut also contain mica exposures, but so covered up by the milling in of the old slopes as to afford very little information of value as to the deposit.

All of the above described developments are as stated located on the properties of the Consolidated Mica Company near Micaville.

Competent expert tests were made by this company of mica stock shipped from their mines to the South Bend factory, to determine its commercial value as electric mica. Through the courtesy of Mr. J. R. Garn, Treasurer, the following records of official dielectric tests made on average samples of Micaville stock, drawn in the rough, and not as customarily prepared for testing, will still serve to show a very acceptable commercial grade of electric mica.

Report on electrostatic test of mica samples, submitted by the Consolidated Mica Company. The samples were split to suitable thickness and tested between ball

terminals at 60 cycles, alternating current, the voltage being applied gradually until the breakdown occurred.

Sample. No.	Thickness of Sample in Inches.	Average Voltage Per Mill. Thickness of Sample.
1.....	.0135	1530
2.....	.0025	4600
3.....	.00325	4200

The results of the test on samples Nos. 2 and 3 indicate a high dielectric strength.

The comparative low voltage per mill of sample No. 1, was due to the condition of the sample, in that cracks were present.

CHAS. A. NASH,
Consulting and Testing Engineer,
3300 Federal Street, Chicago, Ill.

August 12, 1920.

Report on electrostatic test of 12 samples of mica, submitted by the Consolidated Mica Company, from their mines at Micaville, Alabama.

PUNCTURE TEST ON MICA SAMPLES.

Ref. No.	Sample	Size	Thickness	Break-down Voltage Actual	Per Mil.	Surface Leakage
1.....	A.	3½" x 5½"	.004	9600	2400	.....
2.....	A.	3½" x 5½"	.0035	8400	2400	.....
3.....	A.	3½" x 5½"	.005	.....	.....	3"—13440
4.....	B.	3" x 5"	.0065	.....	.....	2½"—14640
5.....	B.	3" x 5"	.0045	.....	.....	2½"—12480
6.....	B.	3" x 5"	.0035	.....	.....	2½"—12240
7.....	B.	3" x 5"	.0025	.....	.....	2½"—12000
8.....	B.	3" x 5"	.002	7920	3960	.....
9.....	C.	3" x 4½"	.002	.....	.....	2½"—10500
10.....	C.	3" x 4½"	.001	6720	6720	.....
11.....	C.	3" x 4½"	.001	7440	7440	.....
12.....	D.	4½" x 8"	.005	14400	2880	.....

Samples with the exception of "D" were split because of small size.

Bottom electrode flat and 1" in diameter.

Top electrode ⅜" sphere.

INDIANA AND MICHIGAN ELECTRIC COMPANY,
South Bend, Indiana.

August 19, 1920.

Stockdale Mica Mine.—The Stockdale mica mine, originally known as the Bell and Kilgore mine, is located partly in the S. E. $\frac{1}{4}$ of the N. E. $\frac{1}{4}$ of Section 25, Township 18 S., Range 10 E., and partly in the N. $\frac{1}{2}$ of the S. W. $\frac{1}{4}$ of N. W. $\frac{1}{4}$ of Section 30, Township 18 S., Range 11 E., immediately adjoining it on the east, and is about 5 miles S. E. of Micaville.

The property is not reported to have been recently mined, but when last examined, in December, 1917, had just been acquired and was being reopened with a view to operation by R. W. Stockdale, T. A. Cornwall and L. F. Haggard, of Gadsden, Alabama. At that time the main developments were the old Bell and Kilgore workings in Section 30, opened up in 1915, which consisted of a shaft and slope, both driven to water level, and there as usual, abandoned for lack of pumping facilities.

Both shaft and slope contained water and could only be examined to that level.

The pegmatite developed by the shaft and slope has a strike of 40° , N.E.-S.W., and a dip S. E., of 60° . To the depth visible, it is apparently altogether kaolinized, containing crystalline quartz, mainly in small angular fragments, the mica being distributed through the mass.

When previously examined in March 1916, there was in the mica house approximately 5,400 pounds of mica, said to have been taken out of the shaft and slope, of which amount 1,400 pounds had been thumb-trimmed, about 2,500 pounds run-of-mine, and the remaining 1,500 pounds, scrap.

The mica stock recovered was a light amber muscovite, running to fair sizes in flat sheet, some of it of high grade, being the remnant of a worked over stock, the total amount of which recovery could not be reliably ascertained.

Developments in Section 25, consisted of six or more shallow surface cross-cuts, opened up in testing four distinct leads of pegmatite, indicated by outcrops as crossing the Section parallel to the pegmatite deposit opened up in Section 30, having the same strike and S. E. dip.

The mica still remaining in these cross-cuts was all small, but of flat sheet of exceptionally high grade.

In the most westerly of the cuts, on the east bank of a small branch or creek running south through the property, the pegmatite exposed carried a bone quartz containing red oxide of iron, with occasional particles of free gold, resulting from oxidation of sulphurets, the branch gravel below the vein affording very fair gold values in the pan.

Douglas Smith Mine.—The Douglas Smith mica mine is located in the S. E. $\frac{1}{4}$ of the S. E. $\frac{1}{4}$ of Section 22, and in the N. W. $\frac{1}{4}$ of the N. E. $\frac{1}{4}$ of Section 27, Township 19 S., Range 10 E., being about $\frac{1}{2}$ mile E. of Coosa river and 3 miles N. of its junction with the Little Tallapoosa. It is the property of the Randolph Mica Company, of Wedowee, Alabama.

The mine location is about midway of the slope of the ridge bordering Coosa river along its east bank, at an approximate elevation of 700 feet above sea level, and is in the S. E. $\frac{1}{4}$ of the S. E. $\frac{1}{4}$ of Section 22. Some developments have also been made in the N. E. $\frac{1}{4}$ of S. 27, but the mine proper as so far developed, is in Section 22.

A body of pegmatite presenting a bold and clearly marked outcrop, has been driven into by means of an open cut in the side of the hill. The character of the pegmatite is a coarse aggregate containing quartz in considerable amounts and of large size, in and around which the mica has been mainly carried.

Mining conditions are therefore unusually favorable, and at the time of the commencement of the late war it was in active operation under the direction of Col. Dallas Smith of Wetumpka, the experienced superintendent being Mr. W. J. Bean. Col. Smith being called to the colors, operations were temporarily suspended and have never since been resumed.

During the last period of operation the mine was equipped with power drills, and all necessary facilities for economic operation, including a small shop provided with a complete outfit of punches, dies, trimmers, etc., in which the output was worked up, graded and sold.

The character of the mica won was exceptionally good, being a clear flat sheet muscovite in fair sizes, containing comparatively few imperfections in the form of folds, or

cracks and no spots or inclusions. It was of light rum color, classing as white in the commercial sheet.

Elsewhere on the property, there is observable a deposit of crystalline flake graphite, which is however as yet undeveloped.

Exhibit sample serial No. 120 is from this mine, at the main opening in Section 22.

CLEBURNE COUNTY.

Cleburne County is comprised within three distinct physiographic belts: the Appalachian Mountain, Piedmont Plateau, and the alluvial area made up of the Tallapoosa river bottoms.

The mica belt or zone, which occupies the approximate central part, runs N. E. to S. W. through the county, lying altogether in the Appalachian.

Topographically, it is principally a deeply eroded plateau, containing many sharp and narrow, and some broad ridges, having summit elevations of 1,000 to 1,500 feet above sea level, its western boundary line being the Tallapoosa river.

In the southern part of the county, within the mica bearing district, areas of the Appalachian Mountain belt are outlying, comprising notably Turkey Heaven, Kemp, and Bald Mountains, and the vicinity of Chulafinnee.

The underlying rocks are mainly mica and hydro-mica, talcose, garnetiferous and hornblende schists, gneiss, and quartzite conglomerates. The quartz occurs mainly in veins, which are in many places gold bearing.

Mica occurrences are in the pegmatites which are of irregular formation in the gneiss and mica schists, with frequent hornblende association, together with surface float of highly crystalline, translucent, and transparent quartz, in fragmentary form, cyanite, and ferro-magnesium rocks.

The Chulafinnee, and the Arbacooche localities, which were active and notable gold mining camps prior to the discovery of gold in California lie within the mica zone of Cleburne, as does also the Turkey Heaven Mountain area which similarly carries numerous gold veins more

or less productive at various periods of free gold, little or no experienced handling practically having ever been given to the sulphurets.

Although some of the largest and best mica ever recovered in Alabama came from Cleburne county, comparatively little prospecting for it has been done, apparently owing to attention having been largely centered on the occurrences of gold and other minerals considered more profitable.

There is much evidence of mica occurrences wholly undeveloped to justify such competent and experienced mica prospecting.

It is a curious fact in this connection that in the grave of a Cherokee Indian which the writer saw opened up, the skeleton was found completely enclosed in a stone box made altogether of large blocks of mica, forming the floor, top and sides. These blocks, or sections of split crystals, were most of them amber muscovite mica of good grade, extremely light in color, and necessarily of very unusually large size for the purposes stated. The precise origin or source of this mica is of course purely conjectural, but as its color, crystallization and all of its characteristics are in precise conformity with mica since recovered in that particular section of the Cleburne mica field where the grave was located, it is a fair presumption that its origin was in all probability not far distant.

While there are a great many outcrops and small old dog-hole prospects scattered through the belt, attention has been called to recent attempts at development only on the Morris and on the Jim Flemming properties.

Morris Mica Mine.—The Morris mica mine is located near the center of the N. E. $\frac{1}{4}$ of the N. W. $\frac{1}{4}$ of Section 21, Township 17 S., Range 10 E.

The pegmatite body exposed by outcrops, lies on the summit, and follows closely the upper edge of the northern escarpment of a steep high ridge, of N.E.-S.W. extension, having a summit elevation of 1,000 feet tidal datum, and a rise of over 200 feet above the Tallapoosa River, the run of which is along the foot of the ridge, N. of the mine, and about $\frac{1}{4}$ mile distant therefrom.

The northern escarpment of the ridge below the mine is abrupt, falling off at a uniformly steep angle of pitch down to the Tallapoosa valley level.

The deposit of pegmatite opened up is, as to district location, placed near the westerly edge of the zone of mica schists generally constituting the mica belt of Alabama, and differs from the formations prevailing in that easterly section of the belt, in respect to being in part made up of basic and igneous rocks, containing hornblende and other ferro-magnesium schists. Local surface occurrences noted, characteristic of this section of the belt, consist of hornblende schists, highly crystalline and translucent quartz, garnetiferous schists, cyanite, etc.

The pegmatite dyke entered lies in apparent conformity with the enclosing formations of garnetiferous red mica schist; has a definite strike of $N.40^{\circ}E.$, dipping $S. E.$, back under the ridge, at an angle (on the surface) of 30 to 40° .

The pegmatite outcrop is traceable on the surface, and is continuously more or less micaized, for a distance of about 200 feet along the strike each way, ($N. E.$ and $S. W.$), from the therefore central point of first development, beyond which terminal points, the ridge falling off, it is covered by shallow residual soil, but may be easily uncovered and its continuity and micarization possibly somewhat extended and examined.

Developments thus far made, consist of surface pits lying in and along the outcrop, but without proper cross cuts to determine the width of the ore body, which however, has been shown to have an observed minimum thickness of 10 feet, with neither foot nor hanging wall as yet revealed.

Characteristic features of the pegmatite are a coarse aggregate of crystalline and semi-crystalline quartz, with feldspar, which has been but very little decomposed or kaolinized.

The mica carried, and recovered from the pits, is in more than usually large crystals very generally sound and tight and free from clay stains or inclusions, and was found distributed through the mass; the upper and lower

contacts, where the micaization is usually centralized, having not yet been opened up or reached.

The freedom of the deposit from crustal movements, is clearly shown by the regularity of all the revealed measures, and is further evidenced by the quite unusual absence of folding or pressure cracks in the mica crystals, which in large measure show perfect forms of crystallization. A limited amount of A-mica was taken out in one pit only on and near the surface, but this defective form of crystallization appears to be entirely confined to this one small locality in the chute as opened up, lessening, and being practically replaced by flat-sheet crystals at the bottom of the cut, a percentage of good flat sheet being in fact recoverable from most of the A-form crystals taken out.

The mica recovered is an amber muscovite of unusually high grade for such surface crystals, splitting well, generally clear sheet, and running in sizes already to 3 x 4 inches.

Mining conditions for economic recovery are most favorable, as the deposit is so readily understandable as to be capable of a complete proving out of all necessary data relative to the proper and most competent and economic points and method of entry before opening up the mine, and has an expectancy of dry mine workings to a considerable depth, as well as of a recovery of sound crystals of flat sheet almost from the surface.

The property belongs to and is being developed by, the Midland Mica Syndicate, of Minneapolis. Exhibit samples serial No. 121 are from this deposit.

Jim Flemming Mine.—The precise location of the Jim Flemming mine could not be ascertained, but its approximate location is in Section 24, Township 17 S., Range 10 E.

It is the property of Mr. Harry Vaughn, and was opened up by Mr. Maddox about the year 1916. The deposit exploited lies high, on the summit of a flat or slightly rolling ridge, at approximately an elevation of 1,000 tidal datum.

It is marked on the outcrop by heavy masses of quartz containing large hornblende crystals (which are scat-

tered thickly over the ground in cultivated areas below the outcrop), has a strike of N.50°E., dipping about 40° S. E., and has been partially opened up along the strike by test pits for a distance of several hundred feet.

First developments stated to have been made by Mr. Maddox was by means of a surface cut, 10 feet deep, of E. and W. extension, intended as a cross-cut. In this cut or pit, a very coarse pegmatite was exposed, made up of a generally unaltered feldspar in large aggregate, interbedded with masses of quartz containing numerous and large hornblende crystals, the mica observed being in fairly large crystals chiefly placed along the quartz contacts, but to some extent carried in the feldspar, where partially kaolinized.

As examined in the cut the mica is a flat muscovite of light amber color, in fair sizes, but tangle-sheet edged, or not free splitting, the sheets being interfoliated with a white incrustation.

Subsequent development for systematic mining was carried on by means of a slope, driven down in the pegmatite body proper from its outcrop, at a point about 75 yards S. W. of the first described pit, and following the dip S. E.

The full width or thickness of the pegmatite, indicated as 6 to 8 feet, was taken out in this slope entry, revealing a top and bottom walling of red mica gneiss.

At the 90 foot level, or the foot of the slope, a left entry had been run out N. E. about 20 feet. The mica recovered from the slope and entry; estimated to be in all about 6 to 8 tons, is at present stored in the mica house precisely as taken out, and is run-of-mine, none of it having been worked up or sheeted. It runs quite uniformly as to size in 2x3 to 4x4 or larger blocks.

From the number of crystals left in place along the hanging wall contact, that contact seems to have been as usual the heaviest mica concentration in the deposit.

Exhibit sample serial No. 122 is drawn from the stock house run-of-mine, on this property.

CLAY COUNTY.

The mica bearing section of Clay county, which lies within the drainage area of the Coosa and the Tallapoosa rivers, physiographically belongs to the Piedmont Plateau province.

It is made up of a belt or zone of comparatively narrow ridges, which belt is from six to fourteen miles in width, entering the county from Randolph, near its northeastern corner, and extending S. W. for a distance of about 25 miles, to the vicinity of Millerville.

The underlying rocks are mainly schists, gneisses, granites, diorites, phyllites and slates, with infrequent shales and quartzites.

A dominant structural characteristic of the rocks is their steep angle of dip and frequent faulting. The surface rocks of the micaized zone are highly metamorphosed crystallines and semi-crystallines, with frequent occurrences and intrusions of diorite and granite dykes, and mainly include feldspathic hydromica schists, muscovite and biotite micas in pegmatites, an argillaceous mica schist, sericitic, garnetiferous, hornblendic, graphitic, epidote, and quartz schists; various iron formations, and the Talladega phyllites. Carboniferous fossils found on the western edge of the mica zone or belt near Erin*, in the Talladega phyllites, indicate that part of these formations belong to the carboniferous.

The Hillabee green schist, occurring in the belt north of Delta, is a fine grained rock of olive-green color; in that locality, as elsewhere in the county, carrying numerous quartz veins.

A prevailing characteristic is the breaking down and weathering of the feldspar component of the rocks into kaolin, which has been largely the case but in lesser degree with the granites as well as with the pegmatites. Along its western edge, and extending through the county S. W., the mica belt or zone is bordered by basic and igneous formations; diorites, hornblende, and other ferro-magnesium schists, the diorites being largely metamorphosed. As in Cleburne county, the muscovite mica

*By Dr. Eugene A. Smith, State Geologist of Alabama.

occurring near the western edge of the mica belt, in more or less close proximity to the ferro-magnesium formations, differs materially from the mica of the central and eastern positions of the zone in respect to color, hardness, flexibility, etc., as the specimens drawn will serve to illustrate.

A line drawn from the Delta mica mine (which is located in the N. E. corner of the county), and having a bearing S.45°W., will be found to lie at all points about centrally of the observed and developed mica occurrences in Clay county as far south as the vicinity of Idaho, or immediately north of the Quenelda graphite mines; south of which point no mica deposits of any apparent importance or value have been as yet noted in the county, although such may be found to exist.

"M. & G." Mica Mine.—The "M. & G." mica mine is located in the S. W. $\frac{1}{4}$ of the N. E. $\frac{1}{4}$ of Section 15, Township 19 S., Range 8 E.

It lies on the summit of a ridge of N. E.-S.W. extension at an elevation of 1,100 feet, tidal datum. The deposit of pegmatite entered has a strike of N.40°E. and is traceable on the surface by visible outcrops at intervals for a distance of nearly a mile.

Original development by the M. & G. Mica Co., of Chicago, Ill., consisted of surface cross cuts and pits, extending over a mile along the strike, directed at the determination of the most favorable point of entry, which was finally selected, and the mine opened up near the N. E. corner of the above described lot.

At this point two slopes were driven 100 ft. apart in the pegmatite body, following its S. E. dip at a slope angle of about 45°. Two cross entries were driven, connecting the two slopes, the first at 75, and the lower connecting entry at 150 feet below the surface, or at the foot of the slopes; one of which was driven lower for a drainage sump.

The last examination made of this mine was in 1914, a few days only prior to its shutting down by reason of litigation arising among the property owners, since which time, and in consequence of which litigation, it has never been actively reopened.

At the time of the examination mining was in progress over both slopes with a full plant equipment of hoisting engines, air compressor and drills, etc. By the entry method adopted, two included sections of the pegmatite body, in size 100x75 feet each, had been solidly blocked out to be partially left for roof support, and in part stoped out, which however was never subsequently done.

Examination of all these exposed faces of the blocked out sections showed mica crystals to a greater or less extent on all of them, mainly carried next the upper contact and bedded on and in the included quartz masses.

Mica recoveries were altogether being made on the lower breast of the second cross entry, where there was a remarkable concentration of amber muscovite, in flat, generally perfect crystals of large average sizes, running from 2x3, to 8x12 inches.

During two successive days spent in the mine watching the recovery, 21 boxes, of 100 pounds each were taken out, nearly all of which was flat, clear sheet, amber muscovite, carrying few imperfections of any kind.

A considerable number of fine crystals still remained in the working heading after this recovery, and all indications seemed favorable to the continuation of the micaization of the chute to lower levels, which was never subsequently done, mine operations being immediately thereafter suspended for the above stated reasons.

The main characteristics of the pegmatite body entered by this mine are a very coarse aggregate of fairly uniform thickness, in excess of 8 feet; the foot wall not having been apparently reached on the slopes. A general conformity to the enclosing mica gneiss walling is indicated as far as developed. Inclusions of quartz masses or horses, micaized with imbedded crystals, are frequent; the feldspar, being but very little kaolinized. Fine crystals of mica were recovered almost from the surface down, there being no evidence of crustal movement in the form of folding, pressure lining, cracks, or imperfections, defective crystallization being largely absent.

In all, and up to the time the mine was examined in 1914, the total amount of mica recovered was stated to have been something over 160,000 pounds.

Of this amount there still remained in the mica shop, an accumulated residue stock of about 21 tons, in which the sheet mica had been all knife trimmed and graded, and was subsequently sold. It was carefully gone over and consisted very largely of mica of exceptionally high grade, running in more than ordinarily large sizes up to 8x12 inches.

No attempts were ever made to test the continuity of the micaized body N. E. or S. W. along the strike, outside the slope limits of the mine proper, or as stated at lower levels, which is to be regretted, as what may prove to be a valuable and extensive body of fine mica is here reasonably indicated.

The best grade, and the largest sizes, of crystals recovered, was, as is in this field usually the case, below water level.

Exhibit samples serial No. 123 is from this mine.

Eureka Mica Mine.—The Eureka mica mine is located in the N. E. $\frac{1}{4}$ of the N. E. $\frac{1}{4}$ of Section 16, Township 19 S., Range 8 E., being about $\frac{1}{2}$ mile distant W. of the M. & G. mine and $1\frac{3}{4}$ miles N. E. of Pyriton station, on the A. B. & A. R. R. It is the property of the Eureka Mica Co., of Birmingham, Ala.

A heavy outcrop of micaized quartz led to the original development by open cut.

As subsequently mined by the Eureka Company, two slopes were driven in the pegmatite, about 50 feet apart, following it on its S. E. dip of about 40° , connected by two lateral cross entries. A main working shaft 130 feet in depth, reaching the pegmatite "vein," connected with the bottom of the east slope for an air course, as shown on Figure 5.

In the east slope, a right entry, 60 feet in length, was run out on the 60 foot level, and a second or lower right entry, about 75 feet continued on to the shaft.

The first or upper left entry at the 70 feet level, 40 feet in length; and the second or lower left, 70 feet long, connected up the two slopes, blocking out some 600 feet of exposed faces, a large proportion of which showed more or less mica crystals in the walls at the time of the examination.

Near the main slope in the upper left, and in the lower right entries, very large crystals of mica were taken out, one weighing over 200 pounds. With the exception of a few stulls, no roof support in the form of timber sets or lagging had been placed in the entries, and but little attempt at effective timbering made on the slopes in consequence of which neglect, most of this work partially caved in at the first rise of mine water, becoming unsafe and was subsequently abandoned. A heavy showing of mica observed in concentration on the upper contact at the foot of the main slope, was thereby involved in this fall, and never recovered.

The pegmatite body entered is made up of an unusual amount of quartz in large masses, around which considerable mica was recovered, the feldspar being kaolinized in the upper levels, but large unaltered in the lower entries. The unaltered spar, carried by analysis, 10 per cent. potash. The larger proportion of mica recovered, was next the contacts and principally with the hanging wall, which is a garnetiferous mica gneiss.

In all, some 50 tons of mica of all classes was recovered in this mine, very little of it being of A-form, and that only near the surface. The large crystals taken out were mainly defective on the edges, but carried good flat mica sheeting well in the body of the crystals, some of it of large sizes.

It is a flat amber muscovite of very light color, containing no spots or inclusions, and by tests made, of high dielectric quality.

The general mine run of sizes are somewhat indicated by the last graded stock sold, which ranged from circle to 6x8 inch, 10 per cent. of the lot running from 3x3, to 6x8 inch.

Owing to inability to secure competent and experienced management and to properly grade and market the mica stock recovered, the mine has been recently idle.

Exhibit samples, serial No. 124 are from this mine.

Delta Mica Mine.—The Delta mica mine is located in the S. E. $\frac{1}{4}$ of Section 4, Township 18 S., Range 9 E., being in the N. E. corner of the county, $\frac{1}{2}$ mile S. of the Cleburne county line. It is the property of, and has been

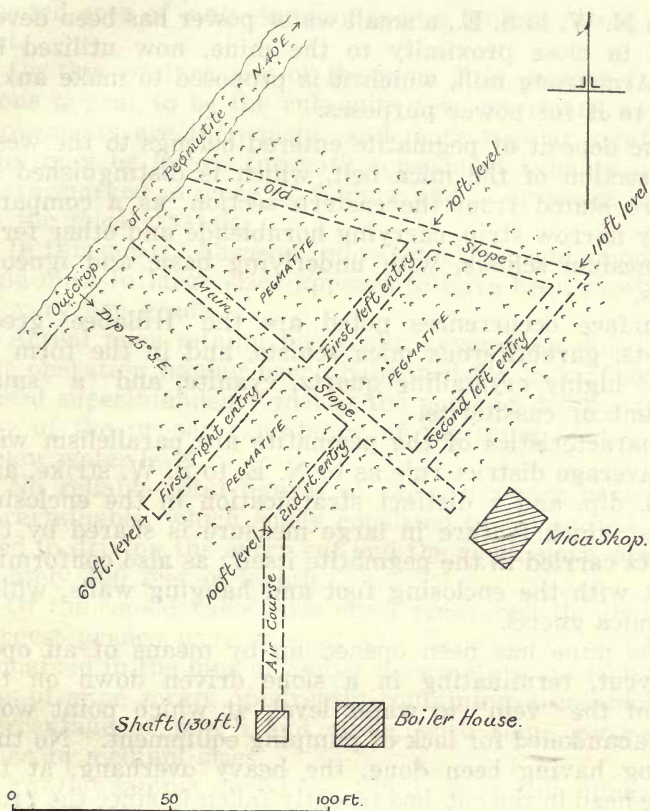


Figure 5.

PLAN of EUREKA MINE.

S16.T19S.R8E.

opened up and operated by Mr. T. C. Russell of Alexander City, Ala.

Topographically, the property lies high, being located near the summit of a rolling plateau area having an elevation of 1,100 feet, tidal datum, this plateau forming part of the western water shed of the Tallapoosa river. On Ketchepedrakee creek, which crosses the property

from N. W. to S. E., a small water power has been developed in close proximity to the mine, now utilized by the Armstrong mill, which it is proposed to make auxiliary to it for power purposes.

The deposit of pegmatite entered belongs to the western section of the mica belt, which is distinguished as before stated from the eastern section, as a comparatively narrow strip, carrying hornblende and other ferro magnesium schists, with underlying basic and igneous rocks.

Surface occurrences noted are the Hillabee green schists, garnetiferous mica schists, and in the form of float, highly crystalline quartz, cyanite, and a small amount of cassiterite.

Characteristics of the pegmatite are parallelism with the average district rule as to N. E. to S. W. strike, and S. E. dip, and a distinct stratification in the enclosing rocks, which feature in large measure is shared by the quartz carried in the pegmatite itself; as also conformity by it with the enclosing foot and hanging walls, which are mica gneiss.

The mine has been opened up by means of an open entrycut, terminating in a slope driven down on the dip of the "vein" to water level, at which point work was abandoned for lack of pumping equipment. No timbering having been done, the heavy overhang, at the slope head in the cut, has recently fallen in since the property was first examined, blocking the mine. When examined before, prior to this caving in, mica crystals were observed on the slope, mainly next the hanging wall, and on both sides down to water level, where the grade and size of the crystals showed a marked improvement.

Small amounts of biotite mica have been occasionally found, and are observable in the quartz on the dump.

The pegmatite chute as far as developed is quite regular, having an average width of about 6 to 8 feet.

Practically all the work done here on the mine proper has been in hard rock, no kaolin in any amount being found, although elsewhere on the property in prospect pits at higher points kaolinization particularly under cul-

tivated area of long standing is to a limited extent present.

On this western rim of the mica field, harder formations appear to be the rule with few exceptions, crustal movements are infrequent, and more regular stratification may be looked for with consequent benefits in the more marked absence of folding and of pressure cracks in the mica crystals.

In this deposit however, more than the usual amount of rule mica in large sizes appears to have been recovered, of very fine grade.

Actual mica mining has really never been done here, the operation having been abandoned for lack of experienced superintendence just at the point of definite recovery of the proper expectancy of the mine, viz: at and below water level.

No reliable total figures of mica recovery have been ascertainable, which solely consisted of the output realized in driving the entry cut and the short slope, approximately 100 feet in length.

Of the considerable mica stock recovered, the best and largest grades were sheeted and disposed of, and there remained in the bins of amber muscovite some 12 tons of run-of-mine scrap, apparently containing a considerable percentage of punch and circle, with some good sheet mica in medium sizes.

Exhibit sample, serial No. 125, is from this mine.

Hurst Mine.—The Hurst mine is located in the N. W. $\frac{1}{4}$ of the S. W. $\frac{1}{4}$ of Section 36, Township 19 S., Range 7 E., about $3\frac{1}{2}$ miles N. W. of Ashland, the county seat.

Topographically, it is situated on a wide plateau broken by low hills, at an elevation of 1,200 feet above tide water.

It is the property of the Hurst estate.

The mica is mainly carried in a large bed of kaolin extending to a depth in excess of 80 feet, or to water level, which feature of the deposit has heretofore limited mica recoveries owing to the difficulty and dangerous character of the deposit without thorough timbering in the shaft and mine workings. Developments have in consequence been largely confined to open surface cuts.

In 1916, Mr. Joe R. Cook, of Birmingham, Ala., leased this mine and sunk an 83 foot shaft centrally of the old surface prospect pits, from which shaft, and in the short bottom entries, Mr. Cook recovered in all about 40 tons of mica.

Toward the foot of the shaft, and in the limited amount of stoping possible without much timbering, on the lowest level, very fine mica was taken out from the kaolin fully 25 per cent. of which was sheet mica running in sizes up to 6x8 inches.

As to grade the recovery was of flat sheet amber muscovite having in color a brownish caste in the thick sheet. Water coming in at 83 feet, requiring pumping and proper timbering, the operation was abandoned and no further mining has since been attempted.

Gibson Mica Mine.—The Gibson mica mine or prospect is located in the S. E. $\frac{1}{4}$ of the S. W. $\frac{1}{4}$ of Section 26, Township 19 S., Range 7 E., being about $2\frac{1}{2}$ miles S. E. of Erin station on the A. B. & A. R. R.

It lies on the top (and midway of its S.E.-N.W. extension) of a ledge, forming the water shed between Mine creek and Buzzard creek (two branches of Talladega creek) at an elevation of 1,200 feet above sea level.

Some 20 years ago, a fine crystal of sheet mica of extremely large size, was found there almost on the surface outcrop, in a cultivated field, which find was the cause of the recent opening up of the pegmatite by Mr. D. F. Gibson, of Birmingham, Ala., who at that time purchased the property.

The work done by Mr. Gibson has been in the nature of prospecting, surface cuts having been made in and around the micaized quartz inclusions of a very coarse pegmatite outcrop, mainly in hard formations, sparingly kaolinized. No attempt was made to open up or to define the form and extent of the pegmatite body beyond the limits of such ordinary surface cuts, not exceeding in depth some 10 to 15 feet.

About 10 tons of mica was recovered in the course of sinking these test pits, practically all of which was still in the mica house when the last examination was made, none having been sold or disposed of to the trade. The

run-of-mine examined, was necessarily hardly representative, and consisted mainly of small sizes, no more large mica having been found so near the surface.

In respect to grade, the recovered stock was largely flat sheet amber muscovite containing no spots or inclusions, but to some extent folded and surface cracked in the largest crystals, such imperfections becoming noticeably less at the depth reached.

Exhibit sample, serial No. 126 represents this run-of-mine stock.

Southern Mica Company.—Examination was made of four mica properties belonging to the Southern Mica Company of Birmingham, Ala., to which attention was called by Mr. Harry Watkins of that Company.

No actual mica mining so far as could be ascertained has ever been done on any of the properties, but all of them have been more or less prospected by the present owners. The four properties are known as the Dye, Smith, Hunter and Brown tracts.

W. D. Dye Property.—The W. D. Dye property is located in the S. $\frac{1}{2}$ of the S. W. $\frac{1}{4}$ of Section 2, Township 19 S., Range 8 E.

Very little prospecting has been done as yet on an easily traceable micaized pegmatite dyke, clearly defined by outcrops along the south edge of and in part crossing, the bone of a narrow, sharply defined and high ridge, at an elevation of about 1,300 feet.

This pegmatite lead or dyke has a strike of N.30° E., dipping S. E. at the characteristically steep angle of this immediate section, approximately 80 degrees. The associated formations are all very similar to those observed at the M. & G. mica mine which is located 1½ miles to the S. E.

J. W. Smith Property. Location, the S. W. $\frac{1}{4}$ of the N. E. $\frac{1}{4}$ of Section 24, Township 18 S., Range 8 E.

On this lot a shaft has been sunk 27 feet in depth, which cuts across a pegmatite body carrying mica, 20 feet below the surface. As cut by the shaft, the micaized pegmatite is approximately 3 feet wide, and appears to carry mica of good quality bedded in kaolin. The dip of the "vein" (which is approximately 30 degrees S. E.)

brings it to the surface where it was first opened on the outcrop, some 40 or 40 feet N. W. of the shaft, in an open cut.

The shaft is located about 30 feet below the crest of the ridge. Following the outcrops of the pegmatite N. E., the deposit has a strike of N. 20 E. generally following but climbing the ridge to and over its crest.

The mica carried so far as developed, appeared to be altogether in the kaolin and of good quality, flat sheet amber muscovite, running to fair average sizes. Recovered amounts were not ascertainable. As the pegmatite lead could be opened at several other places where obviously mica bearing, the property can not be said to have been at all prospected or as yet proven as to the indicated values carried.

J. W. Hunter Property.—The J. W. Hunter property is located in the S. E. $\frac{1}{4}$ of the N. E. $\frac{1}{4}$ of Section 18, Township 18 S., Range 9 E.

Little or no prospecting of any value had been at the time of the examination done on this property, which could only be judged by the outcrops of two pegmatite leads crossing it, one and probably both of which are apparently mica bearing.

J. W. Brown Property.—The J. W. Brown property consists of the N. E. $\frac{1}{4}$ of the N. W. $\frac{1}{4}$ of Section 10, Township 19 S., Range 8 E.

A few small pits only had been opened up on this property, and some good mica taken out, but no competent prospecting done. It is located one mile N. W. of the M. & G., and $\frac{3}{4}$ mile N. E. of the Eureka mica mines.

Weathers Old Mica Pit.—In the S. W. $\frac{1}{4}$ of the S. E. $\frac{1}{4}$ of Section 1., Township 20 S., Range 6 E., is located the "Old Mica Pit," as it is commonly called, on property belonging to the Weathers estate.

The history of this old mine can not be reliably ascertained; at what period it was originally opened, by whom, or for what initial purpose. Possibly it may have been one of the numerous cuts and shafts with which Georgia and Alabama were prospected soon after the Civil War, in a generally inexperienced and wild search for copper. The presence of the ferro magnesium formations, and of the

Hillabee green schists, may have been the determining cause on a copper basis for the extensive work first done here, which consisted of the removal of an elbow shaped surface cut some 150 to 200 ft. in length altogether, and nearly 20 feet deep. In the bottom of the cut are two shafts rumored to have been carried down to a considerable depth, but no accurate information is ascertainable about them, as they are full of water and choked with old timbers and debris. Later operations coming under the observation of old residents now living near by are stated to have been for mica.

Outcrops of mica occur in the sides and slopes of the old cut in many places, carried in soft kaolinized pegmatite. From long exposure, this mica had become rotten and soft, was of medium, running to extremely large sizes, and originally of good quality.

Examination of the old dumps taken from the body of the cut (and which from the size of the trees growing on them must have belonged to the original opening up of the mine) disclosed books of soft mica in considerable amount, of a copperish color resembling phlogopite, but an altered biotite.

To the west of the cut, on the Rader lot next adjoining it, this same peculiar class of altered biotite was found, embedded in the walls of a shaft about 15 feet deep, which had been recently sunk.

Exhibit samples, serial No. 127, is representative of this mica.

Haralson Mine.—A new mica prospect is just being opened up near Sardis Church, in Section 33, Township 19 S., Range 7 E., about 21½ miles S. of Erin station on the A. B. & A. R. R.

The deposit is being opened up by Miss Nellie Haralson of Talladega, Ala., and is developing some amber muscovite mica, in good flat crystals running in size to 3x4 inches.

Exhibit sample series No. 128 is from the mine.

COOSA COUNTY.

Coosa county lies almost altogether in the Piedmont plateau province.

Topographically, it is a very complex and irregular watershed of the various streams constituting a drainage area S. W. into the Coosa, and S. E. into the Tallapoosa rivers. In the western and north western portions, the country is rough and much broken up, ranging from hilly to mountainous, and reaching summit elevations of 1,000 feet above sea level. In the eastern and southeastern portions, the topography is much less abrupt, the hills and generally flat ridges seldom reaching an elevation above 300 to 500.

Mica occurrences have been noted at various points throughout the entire width from east to west of this county, to the east mainly undeveloped, most of the developed deposits being located in the western and north-western portions, along the definite southwest extension into Coosa county of the mica belt as described through the counties of Clay, Randolph, and Cleburne, following their general and constant N.E.-S.W. strike.

The rocks of this section mainly consist as in Clay county of schists, gneisses, granites, diorites, phyllites, and slates, with occasional occurrences of shale and quartzite.

Mica occurrences in the county have received very little attention and no general study, recent interest and development having been altogether diverted to and centered upon the deposits of crystalline flake graphite which are extensive and valuable.

Ivey Mine.—The Ivey mica mine is located in the N. E. corner of the N. W. $\frac{1}{4}$ of the N. E. $\frac{1}{4}$ of Section 15, Township 22 N., Range 16 E.

It is situated about $11\frac{1}{2}$ miles E. of Coosa river, at a point approximately midway between the present main power plant of the Alabama Power Company at Lock 12, and the projected new power plant to be constructed at Mitchell dam, six miles south of it, on Duncan's riffle, in Section 15, on which dam work is already well under way.

The mine was originally opened in 1889 by Dr. P. B. Ivey and G. W. McWade of Birmingham, Ala. Developments made by Ivey and McWade consisted of an open cut on the outcrop, and a shaft 25 feet deep subsequently lowered.

From a comparatively small open cut, and in the sinking of this shaft, there is said to have been taken out by these operators some 25 tons in all of mica, nearly twenty per cent of which is reported to have been run-of-mine sheet of various classes, subsequently worked up in the mica shop and sold.

Somewhere about 1912 to 1915 the mine is stated to have been leased to J. E. Burleson of North Carolina, the results, if any, of whose operation, were not ascertainable.

Subsequently, the mine remained inactive until 1920 when it was leased to the Coosa County Mica Company, during whose term of lease about 45 tons of mica in all was taken out, mainly won over a new slope, driven down 80 feet in the pegmatite from the entry point in the enlarged and deepened old cut marked "C" on the plan of the mine workings.

At this point, and in this operation, a large percentage of the mica recovered is said to have been of A-form. The slope having been back-filled could not be examined, and no samples were available representing the recovered stock taken out by the Coosa County Mica Company.

When visited in January of the present year 1921, development work had recently been in progress by the present owners of the mine, the Scott Investment Company of Montgomery, Alabama, but had just been discontinued owing to unfavorable weather and labor conditions.

A new slope was at that time being driven by the mine owners, located as shown at "A" on the plan, carried down on a 45° slope angle, which slope had been temporarily abandoned at water level, 40 feet down, for lack of adequate pumping facilities.

Little or no lagging was used or required in this slope except at the top, as it lies altogether in the hard and firm red mica schists which constitute both the foot and hanging walls enclosing the pegmatites.

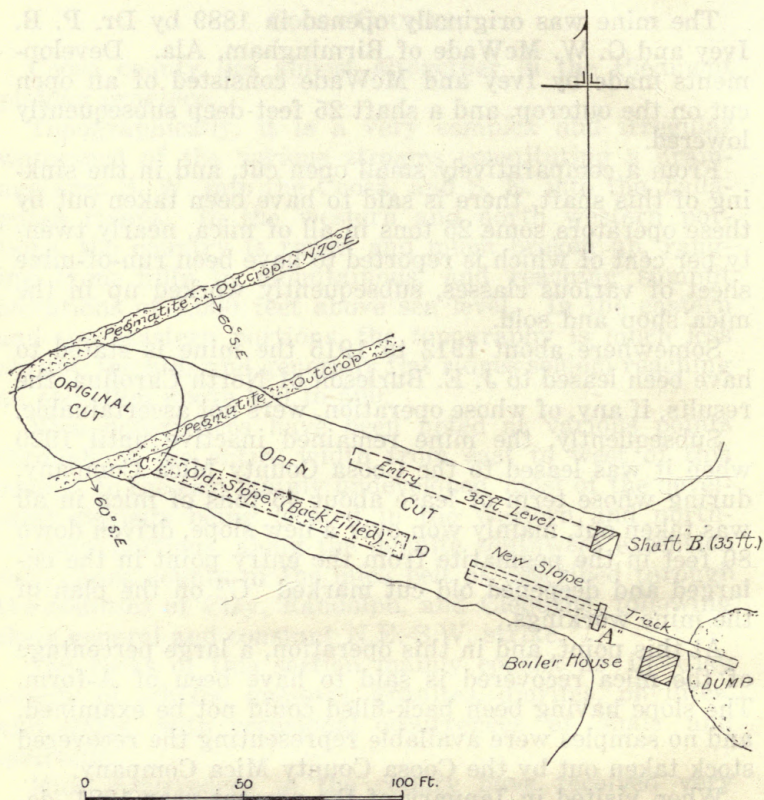


Figure 6.
PLAN of the IVY MICA MINE
S 15° T. 22 N. R 16 E.

The pegmatite body or bodies developed by this mine have the appearance of being either lenticular, the lenses overlapping, or are split (where cross cut by the old open workings), by an intrusive mass or horse of red mica schist.

The general strike of the "vein" is $N.70^{\circ}\text{E.}$, the dip being 60-65 degrees S. E. The various methods of entry

adopted by the different operators have apparently had in mind only the simplest and most rapid recovery of mica with the least possible expenditure of time and capital, and have had no reference to permanent and most economic continuous mine operation.

From the fact that kaolin, some undecomposed feldspar, quartz, and mica show in the shaft all the way down from top to bottom for some 30 to 40 feet (the measures so cut, dipping as stated 60° S. E.) an overlying lenticular mass is here indicated separate and distinct from the underlying pegmatite chute, originally outcropping where it had a thickness of only 6 inches, widening to 2'6" at the lowest point reached in stopping it down.

This overlying and larger pegmatite chute, which would appear to be by far the best expectancy of the mine, has thus far received no practical test, either as to its mica-ized condition in the direction of its strike, or to proper depth following the dip to lower levels.

The pegmatite has no unusual characteristics and lies in apparent conformity with the enclosing schists. A comparatively small amount of quartz of large size has been thus far found to be a component part, and as is generally the case, the best mica recovered has been found on and near such enclosures of larger quartz aggregates.

Also the best grade of mica recovered has been at the lower levels, where A-mica was of less frequent occurrence or altogether absent, and as stated, no test has yet been made of what should be the best expectancy of the mine, viz; below water level.

Other developments made by present mine owners, consisting of the deepening of the old Ivey shaft and the driving of a west horizontal entry some 80 ft. from the bottom of the shaft, were of small practical value or utility for obvious reasons, the entry not having reached the original or underlying ore body, and being largely placed in the intervening schists.

In the various and more recent operations of the present owners, approximately 2,000 lbs. of flat sheet mica are stated to have been recovered, ranging in size from $1\frac{1}{2} \times 2$, to 4×6 inches. Occasional small amounts of biotite have been encountered in the mine.

One car load of scrap was recently taken out and sold, the run-of-mine sheet mica, being knife trimmed and roughly squared to stock sizes.

During the last period of continuous operation a daily average output of about 1,000 lbs. is stated to have been realized, with a working force of 7 men, by the simple use of pick and shovel, hand drilling, and primitive methods generally. Exhibit sample, serial No. 129 is from this mine.

Pond Mine.—The Pond mine is located about 2 miles due W. of Rockford (the county seat) in the N. W. $\frac{1}{4}$ of the S. E. $\frac{1}{4}$ of Section 15, Township 22 N., Range 18 E.

It is a recent development, having been opened in 1920 by the owner Mr. H. W. Pond of Rockford, the work being mainly done by and under the direction of Mr. W. F. Fletcher.

The property lies on the crest of a rolling and irregularly eroded ridge, at an approximate elevation of 700 feet, tidal datum.

Although only one of them has been as yet attempted to be prospected, some three or more parallel leads of pegmatite are by well defined and in places bold outcrops, indicated as crossing the property, having a strike of N.30°E., and dipping at a steep angle of some 60-70° S. E., the approximate width of the belt made up of the separate formations being 300 to 400 feet.

Mine development has been by means of two shafts, the main shaft, about 50 feet in depth, and the upper or westerly shaft, 10 ft. deep, connected by a stope on the slope angle of the pegmatite.

At the foot of the incline stope and bottom of the main shaft horizontal entries or rooms, running N. E. 10 feet and S. W. 30 feet constitute the working mine. From the entries and stopes about 12 tons of mica in all were stated to have been taken out and partially disposed of to the trade.

At the time of the examination, in March 1921, about 2 tons remained in the mica house of punch and scrap, with some 500 to 800 lbs. of run-of-mine sheet thumb trimmed.

Exhibit sample series No. 130 is from this remaining stock, and possibly not fairly representative.

Cowart Mines.—Three localities were examined belonging to Mr. J. C. Cowart of Rockford (resident on the property owned) and on which recent mica development work has been done by Mr. W. C. Fletcher. The localities developed all lie about one mile S. of the Pond mine, and about 2 miles S. W. of Rockford.

The S. E. $\frac{1}{4}$ of the N. E. $\frac{1}{4}$ of Section 21, Township 22 N., Range 18 E.

On this property a shaft had been sunk 30 ft. to water level, with a 10 foot entry in the pegmatite at its base. The pegmatite driven through is an aggregate made up of kaolin, quartz in considerable amount but of small size, in angular fragments, and mica; the mica being of small sizes, somewhat wavy, and having a slightly greenish caste.

About 400 lbs. in all had been recovered and was piled up on the ground. The deposit is called by Mr. Fletcher the "Hatchet Vein."

The N. E. $\frac{1}{4}$ of the N. W. $\frac{1}{4}$ of Section 22, Township 22 N., Range 18 E.

Developments here made by Mr. Fletcher were by a shaft 15 feet in depth, from the bottom of which a stope had been driven down following the dip of a pegmatite chute about 2 feet wide for a distance of 30 feet.

The mica found was altogether of A-form near the surface, improving at the lowest depth reached, where it occurred in connection with kaolin of fine quality.

About a ton of scrap mica was lying on the dump, mostly of A-form.

The S. W. $\frac{1}{4}$ of the N. W. $\frac{1}{4}$ of Section 22, Township 22 N., Range 18 E.

On this property a shaft had been sunk 35 feet deep from which a drift had been run out east 30 feet altogether in soft kaolin, no mica in any amount having been recovered.

E. E. Brown Property.—The S. W. $\frac{1}{4}$ of the S. W. $\frac{1}{4}$ of Section 11, Township 22 N., Range 18 E.

About 50 yards west of the Rockford Road, a shaft 35 feet in depth had been sunk by Mr. Fletcher in a soft

white schist. A small deposit of mica had been cut into near the bottom of the shaft at water level containing only crystals of small size.

Mica outcrops of favorable character are of frequent occurrence in the cuts and along the main road leading from Rockford N. E. to Kellyton for a distance of eight or nine miles, but no developments have been made except in the vicinity of Crewsville, and on both sides of the crossing by this road of Jack's creek, in Sections 34 and 35, Township 23 N., Range 19 E., in which localities some mica mining has been done, not however in recent years.

There is a considerable area in that vicinity which from appearances is mica bearing, and might be well worthy of investigation.

Thomas Mica Properties.—Openings have been made and some mica mined on the properties of J. H. and E. B. Thomas located 4 miles east of Rockford near Hissop. From the developments made quite an extensive deposit of A-form and fish-bone mica is indicated, as also a fine flake mica in a decomposed schist, which may have utility by some method of concentration. The prevailing rocks are granite and gneiss. The location has been noted before in publications of the Ala. Geological Survey for the occurrence there of beryl crystals of yellowish green to aquamarine color in the quartz outcrops.

Exhibit samples, serial No. 131 are from this property.

CHILTON COUNTY.

The extreme south western end of the Alabama mica belt is comprised within that portion of eastern-central Chilton county, lying west and southwest of Coosa river, and east of the Louisville and Nashville Railroad.

Its general geologic conditions are precisely similar to those occurring in the adjoining section of S. W. Coosa county, east of Coosa river, of which area it is the S. W. extension.

Mica occurrences of indicated value have been noted and to some extent opened up in this section of the county, but systematic efforts at development have been pre-

vented by litigation of long-standing in the courts, affecting the common ownership of the mineral interest in some 30,000 acres, inclusive of the mica bearing properties.

The close proximity of these deposits to present available hydro-electric power, should be a favorable factor in their development, if they prove to be extensive and valuable, as soon as the ownership questions now in litigation are definitely and finally settled or adjusted.

PART III.

KAOLIN.

AS BEFORE stated, the utilization of the kaolins, which are the almost universal accompaniment of the mica deposits of Alabama, should be, as a by-product, an important economic factor in assisting mica development.

No systematic study has as yet been given to these kaolins to determine their precise commercial value, both in the raw state, and properly prepared (by separating out the quartz and mica components) for use in porcelain making, and in the finer grades of pottery manufacture, for which purpose they have unquestionable adaptability.

Sufficient tests however have been from time to time made to show that the finer grades of pottery have been and can be made from these kaolins, and it remains to be clearly proven by reliably exhaustive and expert tests, that the amounts of such clays available at given points are sufficient to justify the necessary mining and flotation plant equipment.

As a result of careful study given to the mica-kaolins in the recent going over and examination of all or nearly all of the actual mica developments in the state which is just concluded, together with prior study and examinations covering a period, at intervals, for some twenty-five years given to the subject, it may be stated with all due conservatism, that in economically recoverable amounts these kaolin by-product accompaniments of mica are present in sufficient amounts and necessary concentration at a considerable number of localities.

In arriving at this estimate, attention has been centered upon the three essential factors, viz: the area indicated of the kaolin beds individually, the depth to which the spars have disintegrated, and the variable amounts and character of the over-burden carried.

The usual and competent boring tests made by clay experts, should when made bear out this statement, and prove these facts conclusively.

In every notable instance of important kaolin deposits, water supplies, amply sufficient for flotation, are present and closely adjacent.

Throughout the mica field, timber for mine, plant construction, and fuel purposes, is generally present in sufficient amount for a considerable period of operation, and as previously stated, hydro-electric power, either already on the transmission lines, or in the making is now and will be in larger amounts subsequently available as a permanent future basis of economic power for plant and mine operation, by reason of its frequent proximity, and the fair and favorable ruling rates for contract power service.

In view of these facts, such analyses and partial tests as have been at various times made, become of sufficient interest to be here stated as possibly justifying the complete, competent, experienced, and thorough study of Alabama mica-kaolins, which it is confidently hoped may soon be made.

Attention was first called to the value and possibilities of Alabama porcelain clays by Michael Tuomey, State geologist, in the second report made for the Alabama Geological survey in 1855.

Following the suggestions and opinions advanced by Tuomey, the Alabama Kaolin Company, later on in 1888, (acquiring large property holdings at and near Micaville, including the above sections) submitted proper samples of clay from that locality for testing to Mr. Henry Brunt, manager of the Chesapeake pottery, Baltimore, for practical pottery test.

Preliminary to these practical commercial tests the following analyses were made of the Micaville kaolin.

DEPARTMENT OF THE INTERIOR.
UNITED STATES GEOLOGICAL SURVEY.
DIVISION OF CHEMISTRY.

Report of analysis No. 949. Sample of Kaolin for analysis:

	%	
Water H ₂ O	18.50	5.02% at 120°C. 13.48 at red heat.
Silicia SiO ₂	43.21	
Aluminum Oxide Al ₂ O ₃	37.27	

Calcium Oxide CaO} .....	.11
Magnesium Oxide MgO} .....	.10
Potassium Oxide K_2O} .....	.28
Sodium Oxide Na_2O} .....	.40
Iron Oxide Fe_2O_3	Trace
	<hr/> 99.87

The feldspar is the normal potash feldspar containing a very small amount of iron, .25%.

Examined by Charles Catlett and reported July 26th, 1887.

(Signed) W. F. HILLEBRAND,
Acting Chief Chemist.

(Note)—Sample from Section 7, Township 18 S., Range 11 E., Randolph County, Ala.

In the letter of transmittal of the above analysis Mr. Hillebrand says:

"The supposed kaolin has been analyzed in full and found to possess practically the composition of a pure kaolin. Whether it is suitable for use in the manufacture of porcelain can only be determined by subjecting it to tests of a practical character which this laboratory cannot undertake to execute.

"This information can best be obtained by submitting samples to some manufacturer of pottery or porcelain.

"The feldspar would doubtless be suitable for the purpose of porcelain as it contains but a minute quantity of iron."

Samples of the quartz, feldspar, and kaolin, drawn from the same locality, and submitted for laboratory test in 1889 to the State chemist, N. T. Lupton, at Auburn, Ala., were analyzed and reported on as follows:

N. T. LUPTON, STATE CHEMIST.
STATE CHEMICAL LABORATORY.
AUBURN, ALABAMA.

March 4, 1889.

The specimens of Feldspar, Kaolin and Quartz from Mr. J. R. Abrams of Greenville, Ala., have been carefully analyzed with the following results:

	<i>Feldspar</i>	<i>Kaolin</i>	<i>Quartz</i>
Moisture	0.20	6.45	.....
Water of Combination.....	0.80	13.25	0.20
Silicia	63.13	42.63	98.45
Alumina	21.18	37.26	0.87
Iron .....	.....	.....	.....
Lime	Trace	.048	Trace

Magnesia	1.08	Trace	.....
Sodium	3.93	.....	.....
Potassium	9.38	.....	.....
	<u>99.70</u>	<u>100.07</u>	<u>99.52</u>

(Signed) N. T. LUPTON,
State Chemist.

Out of the samples of Randolph county kaolin sent to Mr. Brunt for practical test, there was made up 6 ornamental and decorative pieces of transparent china, consisting of framed plaques, mirror frames, cups and saucers, and 10 pieces of opaque porcelain, consisting of plates, cups and saucers, flower vases, etc., which were entered in competition with other potteries at an exhibition held in Philadelphia in November 1889, and were there awarded medals and honorable mention in seven classes, taking, as stated by Mr. Brunt, "first prize in open competition with all American manufacturers."

Commenting on this exhibit, and its eminently successful results, Mr. Brunt says:

"The chemical composition of the clay is almost the same as that of the celebrated St. Stephens kaolin from Cornwall, England. I have not used any mineral stain, the material being entirely free from iron, and there being no foreign coloring matter to counteract. The clay has been burned in the biscuit kiln to about 3,000° F., and about 2,700° F. in the glass. Being entirely free from coloring matter, a little difference in temperature during burning does not alter its color. The leading idea throughout has been to produce an opaque porcelain body from American materials, as pretty and artistic as French china and as durable as English earthenware at a moderate expense—with a body and glaze obtained on different principles from those on which American porcelain of the present day is produced, recognizing the fact that the great fault with American earthenware heretofore has been its want of durability. The materials are from virgin mines in Alabama, and I have worked on the principle of using more to produce a body not so susceptible to variations of temperature."

The above practical test, and its judgment by the leading clay experts of this country, would seem to be con-

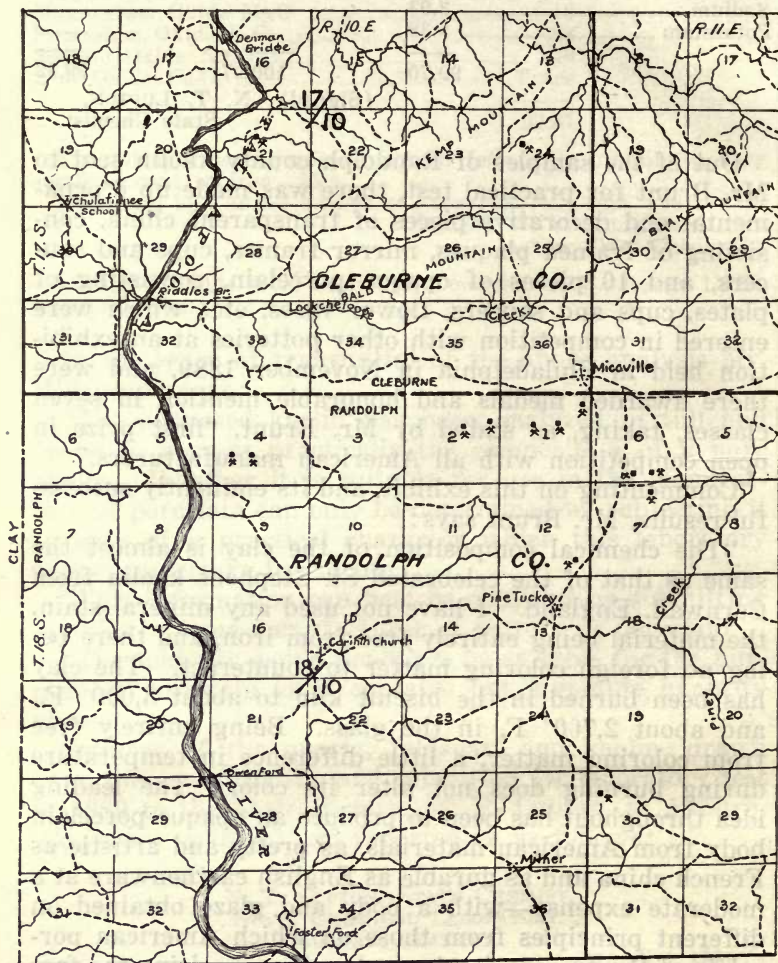
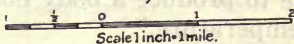


Figure 7.

MAP
SHOWING LOCATION OF
MICA MINES
In the vicinity of Micaville.



Sections.

6	5	4
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Mica Mines. * * *
Roads. - - -

clusive evidence of the availability of Alabama kaolin for porcelain manufacture.

Subsequently, a tentative proposition was made by a leading pottery to erect a plant in this State, provided sufficient amounts of kaolin of the grade used in these tests could be convincingly shown by practical tests to be available.

The above detailed analyses and tests were as stated based upon the mica associated kaolins of the Micaville district, Randolph county.

Exhibit samples, series No. 132 represent this kaolin.

For possible utility in the manufacture of fire brick, the mica-kaolins have also been given some consideration.

At the time that samples of Micaville kaolin were submitted by the Alabama Kaolin Company to Mr. Henry Brunt for pottery test, mixed samples from the same locality, composed of quartz, feldspar, mica, and kaolin, were also submitted for refractories testing in the manufacture of fire brick.

The analysis of the samples submitted was as follows:

DEPARTMENT OF THE INTERIOR.
UNITED STATES GEOLOGICAL SURVEY.
DIVISION OF CHEMISTRY.

Report of Analysis No. 1148.
Labelled "Fire Clay."

Material received from J. R. Abrams, Greenville, Ala.

Material consists of fragments of quartz, feldspar and mica intermixed with about 40% of what is apparently Kaolin. Analysis made on material as sent in.

	<i>Per Cent.</i>
Water at 110°C., H ₂ O .....	.06
Water at red heat, H ₂ O	6.72
Silica, SiO ₂	69.84
Alumina, Al ₂ O ₃	19.91
Ferric Oxide, Fe ₂ O ₃ .....	.90
Manganese Oxide, MnO	Trace
Lime, CaS .....	.07
Magnesia, MgO .....	.28
Potash, K ₂ O	2.14
Soda, Na ₂ O .....	.21
	<hr/> 100.13

Examined by Thos. M. Chatard and reported Feb. 25th, 1890.

(Signed) F. W. CLARK,
Chief Chemist.

Out of 70 per cent. of the mixture above described, with an admixture of 30 per cent. of an ordinary plastic clay, Mr. Brunt prepared specimen bricks which stood the most rigid tests, having been finally subjected to a temperature of 5,000° F. for three weeks in a steel melting furnace without showing any sign of fusing.

The completion of the test as to the ultimate fire resistance of the brick in respect to time, was prevented by the fusing of the supporting and underlying brick in the bridge wall, there having been insufficient material furnished out of which to build the bridge wall entire.

During the year 1920, similar tests although not carried to the point of actual pottery manufacture, were made by the Coosa County Mining Company on the associated mica-kaolins from their Mica Hill mine near Dadeville, Tallapoosa county, representing an entirely different district, locality, and environment.

The physical characteristics however of the two clays were very similar, and their composition as shown by the following analysis differs very slightly.

THE BATTLE LABORATORY.

Montgomery, Alabama, Nov. 10, 1920.

No. 70994. Analysis of Sample Kaolin.

Received from the Coosa Co. Mica Co., Wetumpka, Ala.

	<i>Per Cent.</i>
Moisture	2.42
Silica	45.62
Oxide of Aluminum.....	38.26
Combined water	13.24
	<hr/> 99.64

Note.—A very pure Kaolin Clay.

(Signed) THE BATTLE LABORATORY.

In co-operation with the Alabama Geological Survey further tests of this clay were made by Dr. H. Ries of Ithaca, New York, at the instance of Dr. Eugene A. Smith, State geologist.

Quoting from Dr. Reis report to Dr. Smith he says:

"The clay sample submitted is evidently a white residual clay, in fact it is one of the whitest I have ever seen.

It contains but little coarse grit but seems to have quite a few small scales of white mica.

A sieve test shows that all of the clay except 9.7 per cent. passed through a 200 mesh sieve. It would however be desirable to wash the product, or put it through a process of air separation before shipping it to market.

"A sample of the clay was put through a series of physical tests, but previous to this it was washed through an 80 mesh sieve. The portion passing through was then allowed to settle and dried. This washed clay is very white, but its plasticity is not very high, in fact it is lean, and has a mealy feel. It would require to be mixed with a more plastic clay before it could be molded in pottery making.

"With this low plasticity there is also a rather low strength to the material in its air dried condition. This was determined from the modulus of rupture which was 40 lbs. per sq in.

"The linear shrinkage in air drying was 7 per cent. and is normal.

"The clay was fired at six different temperatures, and the shrinkage and absorption noted after each except the last. The results follow:

<i>Temperature</i>	<i>Fire Shrinkage</i>	<i>Absorption</i>
950°C.	0.0%	Too soft and porous.
1150°C.	4.0%	35.2%
1190°C.	5.0%	30.0%
1230°C.	6.0%	23.5%
1310°C.	6.0%	15.0%
1730°C.	Nearly fused.	

"These tests showed that the clay fires to a very porous body, characteristic of most true kaolins. It does not become steel hard until above 1190° C., and the color after firing is very white. Neither the linear air shrinkage nor the fire shrinkage are excessive.

"The clay appears to be an excellent one. Its white burning character together with its refractoriness should make it of value in the manufacture of porcelain, white earthenware, electrical insulators, or other wares in which this type of clay is required.

"I further believe in its washed condition it could be sold to paper, rubber or paint manufacturers, as these several industries consume a considerable quantity of white gritless clay."

In line with the results of the above tests made by Dr. Reis and his suggestions, samples of this clay were submitted to the Mercer Pottery Company of Trenton, New Jersey, and after testing resulted in an order for a sample carload, which was shipped to Trenton in April of the present year, the car-load being crude run-of-mine.

This large sample has since been worked up but the results have not yet been ascertained. Exhibit sample, series No. 133 was drawn from this car load shipped to Trenton, N. J., and represents the run-of-mine kaolin.

Preliminary flotation tests are now being made for the Coosa County Mica Company on the run-of-mine mica-kaolin from the Dadeville mine, to determine the best and most economic method for washing this clay, which will effect a clean preparation of kaolin, together with the complete separation of the small amount of finely divided quartz from the mica carried in the tails;; giving three clean products, the relative commercial values of which individually, so prepared, it is proposed to ascertain by submission of samples to the trade.

In a preliminary test just completed by the Simplex Ore Separating Process, using a four cell flotation machine with hydraulic agitation, a practically complete separation of the three products was experimentally effected without difficulty, the test being conducted under the supervision of Dr. D. C. Picard of the Picard Laboratories.

It is apparent from this test that the desired handling of this particular clay presents no difficulties other than those which are clearly understood and have been successfully solved by various methods.

The flow sheet of a satisfactory plant would be simple, and would probably be made up of some best adapted form of disintegrator, followed by four flotation cells (three rougher and one kaolin) the product to be handled over Wilfrey or Overstone tables, with final recovery of the washed kaolin in settling tanks.

Exhibit samples, serial No. 134, represent the flotation test above described, being drawn from the heads and tails during the experimental run.

In the index to the Mineral Resources of Alabama, issue of 1904, by the Alabama Geological Survey, additional analyses of the kaolins (which is the term uniformly used here to designate only the residual material from the decomposition of feldspars in the area of the crystalline or metamorphic rocks) are given and are quoted as further evidence of the comparative uniformity and favorable character of these mica-kaolins in other localities of the mica belt, for porcelain making.

†Composition of Kaolins.

Locality	Silica	Alumina	Ferric Oxide	Lime	Magnesia	Alkalies	Ignition	Total
1. Washed Kaolin, 1½ Mi. N. E. of Milner, Randolph County	47.75	38.00	.20	*	*	*	14.85	100.80
2. Washed Kaolin, 1½ Miles S. E. of Mica-ville, Cleburne Co.....	45.20	38.00	*	.22	*	*	15.90	99.32
3. Kaolin, J. B. Ross, Miller Place, Mica-ville Cleburne Co.....	46.88	39.97	.08	.30	*	.64	13.87	101.74
4. Kaolin from S½ S. S. 28, Tp. 18, R11E. Senator McIndoe, Randolph County	42.41	38.33	.....	.....	.70	.....	17.42	.....

*Trace.

†Mineral Resources of Alabama 1904 Ala. Geological Survey.

Exhibit samples serial No. 134 represent the flotation test above described being drawn from the heads and tails during the experimental run. In the index to the Mineral Resources of Alabama, issue of 1904, by the Alabama Geological Survey, detailed analyses of the kaolins (which is the term uniformly used here to designate only the residual material from the decomposition of igneous in the area of the crystalline or metamorphic rocks) are given and are quoted as further evidence of the comparative uniformity and favorable character of these mica-kaolins in other localities of the state, for porcelain making.

Composition of kaolin, No. 881 and serial composition of kaolin, No. 882.

Analysis of kaolin, No. 881 and serial composition of kaolin, No. 882.

Analysis of kaolin, No. 881 and serial composition of kaolin, No. 882.

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